4-1 General.

The information in this chapter can help the planner/designer identify and resolve both the needs of new Army service school buildings and the problems of existing ones. It gives Army service school facility users a reference for judging space needs and evaluating space quality. The purpose of this information is not to give patent answers, but to help Army service school users understand local space needs and encourage the planner/designer to produce a creative, successful solution responsive to local needs. Army service schools are divided into four major space types: training, training support, office and shared spaces. Each of these is subdivided into specific kinds of spaces. (Figure 4-l). This chapter presents design

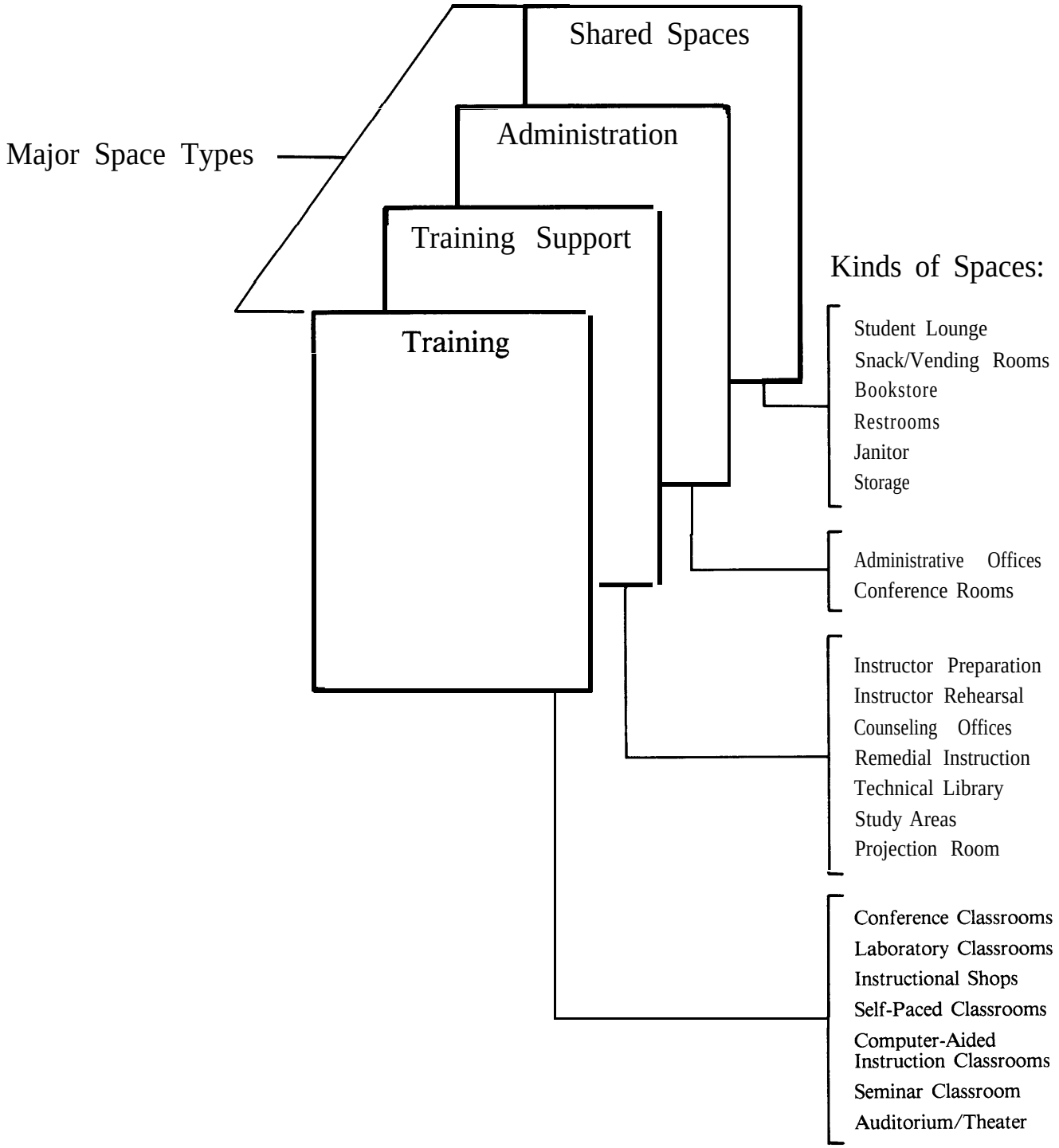


Figure 4-1
Types of Design Requirements.

information in the form of requirements and criteria for all space types. REQUIREMENTS either help define problems or explain what requirements. Information about each space type is presented in two formats. First, design requirements and criteria are presented in the form of assumptions and planning/design data. (Figure 4-2). Local users should verify the assumptions for use by the planner/designer. If necessary, the assumptions should be modified to reflect actual usage and activities, occupants, equipment and supplies, and schedules of the local situation. Second, at the end of each section, requirements and criteria for that space type are summarized in a table.

4-2 Conference Classrooms.

A. Use/Activities.
One or more instructors typically use classrooms to conduct lectures, presentations, or demonstrations, using a variety of training aids. The primary activities of the students are seeing, hearing, and writing. Requirements and criteria for effective communication and the ability of the instructor to establish a relationship with students vary with group size, teaching methods, and media used.

B. Occupants.
The number of instructors, including teaching aides or technicians, may vary from one to 10. The audience could be as large as 200.

C. Equipment/Supplies.
The instructor may need a platform, chalkboards, tackboards, map hangers, projection screens, and equipment for demonstrations at the front of the room. A lectern, table, or desk may also be needed. Desks may have to be arranged in temporary or permanent tiers so that students can see the instructor and/or training aids. These desks should have a writing surface. Tables and chairs may also be used. Projection or sound equipment that is kept permanently in the classroom should be placed on movable stands or mounted securely. Other demonstration/training aid equipment can be stored next to the classroom.

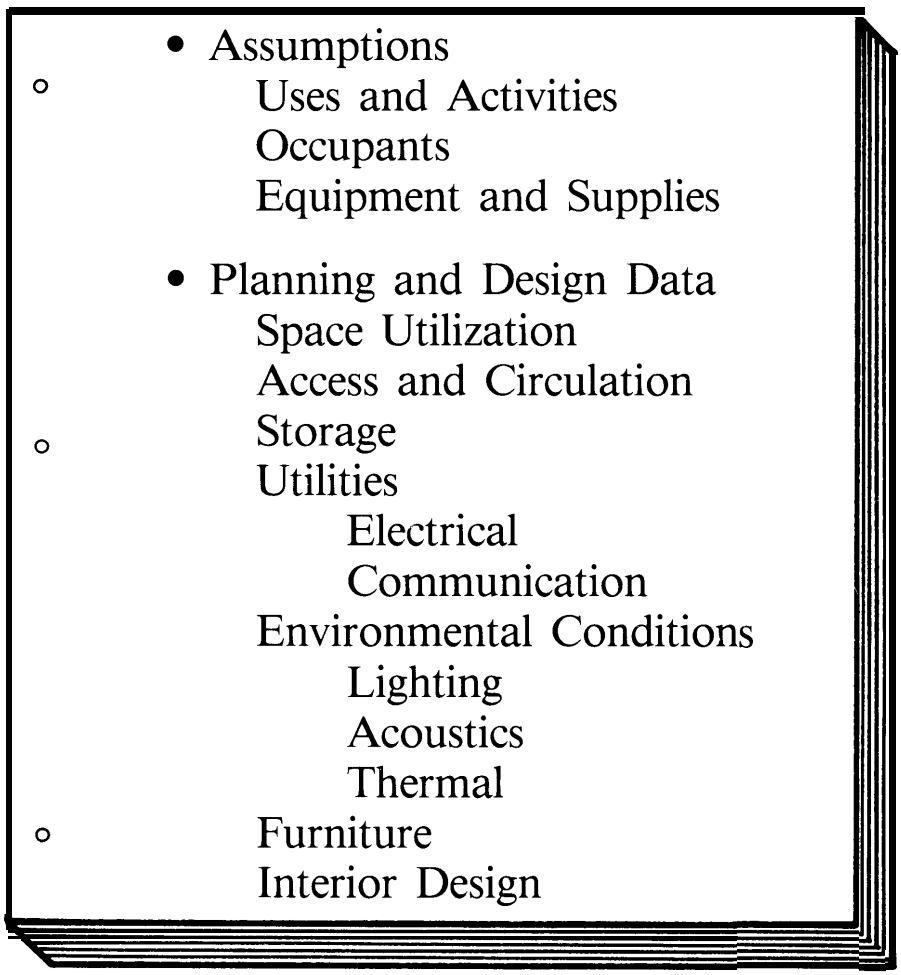


Figure 4-2
Types of Design Requirements

D. Space Utilization.
Classroom space should be sized to support a variety of classes, instruction methods, and classroom activities. A lower limit of 25 square feet applies to classrooms which just require chairs that do not have note-taking arms. An upper limit of 35 square feet applies when there is a continuous need for audio-visual (A-V) presentations, writing surfaces, and the use of reference materials.

E. Access/Circulation.

(1) Location.
A classroom should be conveniently located and away from noisy areas. The classroom should be separated from spaces that require privacy, but near other training spaces. It is best to centrally locate a frequently used classroom (Figure 4-3 and paragraph 5-2 below).

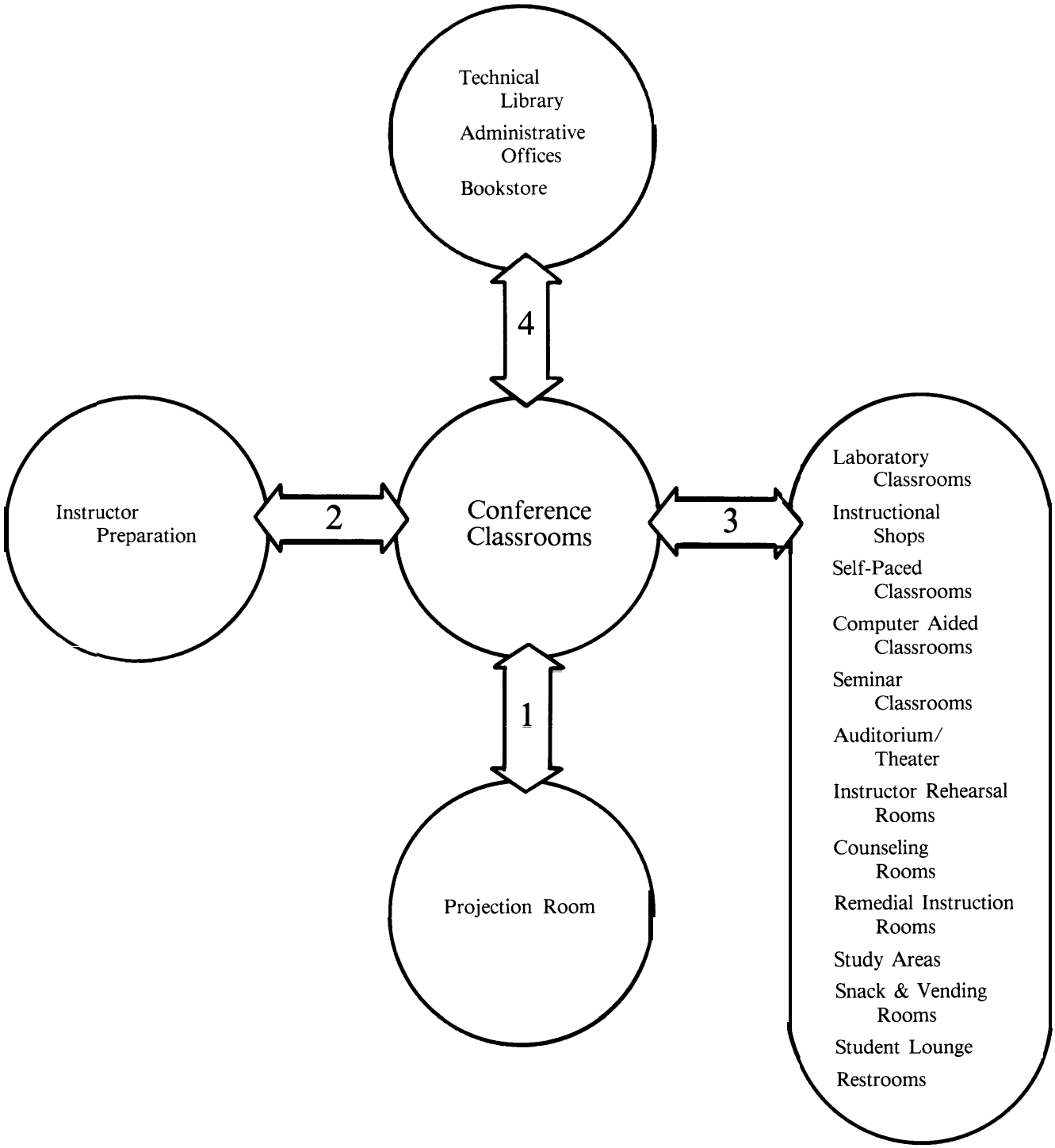


Figure 4-3
Spaces Near Conference Classrooms.

(2) Circulation Within Room.
Furniture and training aids should be arranged to provide good visual contact between the instructor and students, to allow students to see images on projection screens easily, and to permit safe exiting in emergencies. Windows should be located along the sides so that neither students nor instructors have to look into the glare of window-light. Seats for students should not be closer than 2W nor farther than 6W from a projection or television screen of width W. Refer to paragraph 3-4 above. Aisle widths and locations and the number of seats which can be placed together between aisles must comply with life safety standards.

(3) Room Openings and Access.

a. Late students should be able to enter classrooms without disrupting class activity. At least one door should be at the rear of the classroom.

b. Access to classroom conducting classified instruction should be controlled. See guidance on physical security in FM 19-30.

c. Circulation around and into classrooms should be easy and provide for safe exiting in emergencies. All doors should be at least 3 feet wide and recessed so as not to stick out into the corridor when opened. Doors must swing out from the room. Two exit routes should be provided from each classroom; more may be needed for very large classrooms to meet life safety standards.

(4) Movement.
Movement of equipment in and out of classrooms should be easy. Classroom doorways should not have thresholds. Where large furniture or equipment is used, double doors should be provided or the doors sized to allow easy movement of equipment.

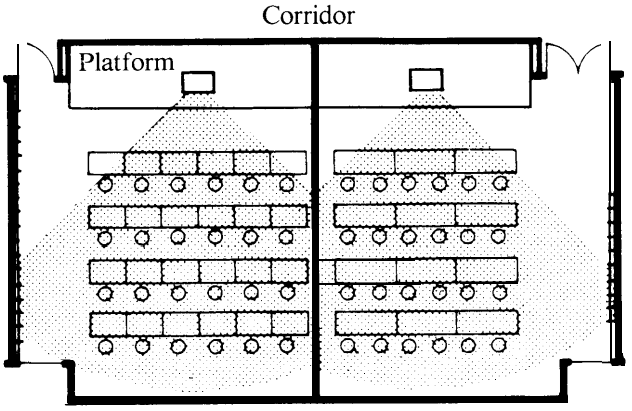
F. Effect of Audio-Visual (A-V) Systems on Seating Arrangements.

(1) Considerations.
Seating arrangements should be planned to support A-V aids for object demonstrations. Student viewing should be the primary concern in developing instructional spaces. Conference rooms for fewer than 50 students, intended for lectures which stress screen projection A-V, will not need sloped floors or risers for seating. Conference rooms for object demonstrations of techniques and equipment or for dialogue between students and instructor will need either a permanent or portable riser system. The number of seating rows, the lecture platform height, and the lowest height of demonstration (focal point of viewing) determine the respective heights of the riser elements. Refer to paragraph 3-4 above.

(2) Sample Arrangements.

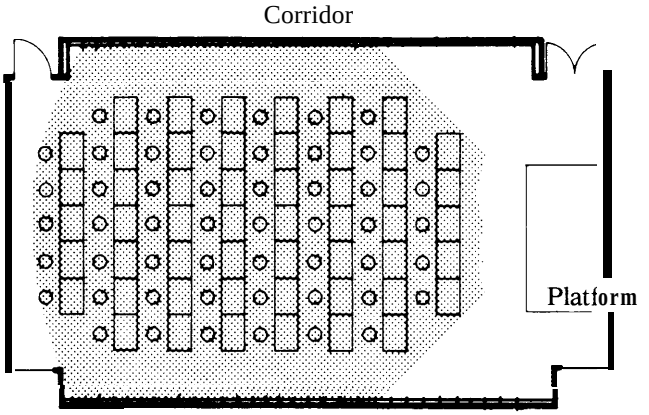
a. The seating arrangement in Figure 4-5 is typical for conferences, lectures, and A-V presentations on a screen at the front wall.

b. The seating arrangement in Figures 4-4 and 4-6 is for equipment demonstrations and television viewing. In Figure 4-6, viewer-to-object distance for demonstrations is shorter than given in Figure 4-4; however, A-V screen presentation is not satisfactory because the viewing angle is too oblique for students seated at the side. Television viewing from the two positions shown lets all students see well.



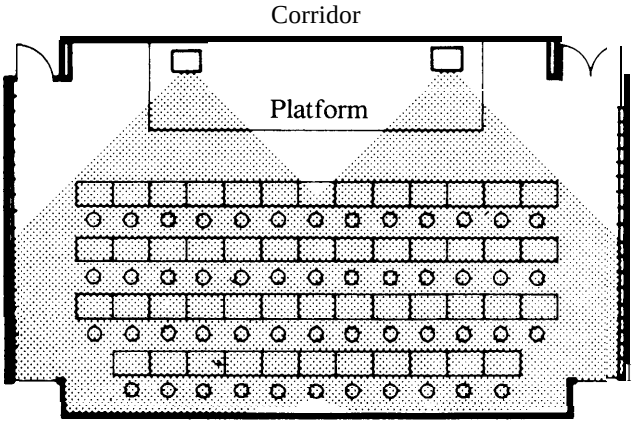
Dimension: 25 feet by 30 feet.
Ceiling Height: 10 feet.
Seating: 24 individual stations with table 2 feet by 3 feet or 12 shared stations with table 2 feet by 5 feet.

Figure 4-4
24-Student Classroom.



Dimension: 30 feet by 50 feet.
Ceiling Height: 10 feet (maximum riser height 2 feet).
Seating: 50 individual stations with table, 2 feet by 3 feet.

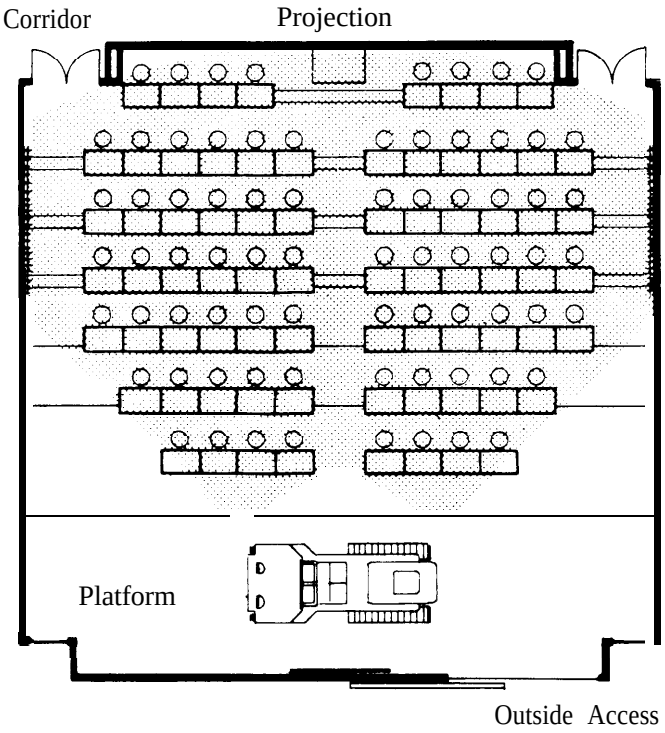
Figure 4-5
50-Student Classroom Using Projection Methods of Presentation.



Dimension: 30 feet by 50 feet.
Ceiling Height: 10 feet (maximum riser height 2 feet).
Seating: 50 individual stations with table, 2 feet by 3 feet.

Figure 4-6
50-Student Classroom Using Television Presentation Methods.

c. In Figure 4-7, the arrangement is for platform lecture, screen projection, television A-V presentation, and equipment demonstration. Entrance to the room from the corridor is near the midpoint of the risers; movement is up or down to the seating area and to the platform for equipment demonstration and lecture. The 50-foot room width is consistent with modular school construction. The depressed floor allows integration of this space with adjacent grade-level areas having 10-foot ceilings. Site area adjacent to the exterior wall should be contoured to allow equipment to enter platform areas below grade level.



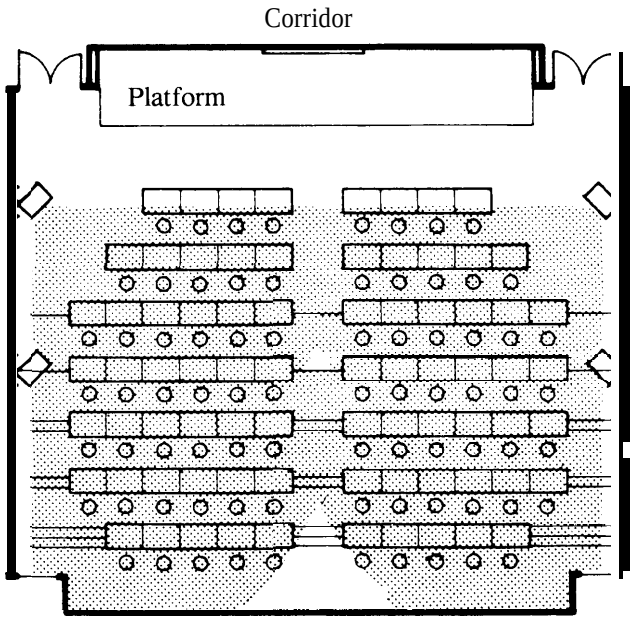
Dimension: 50 feet by 55 feet.

Ceiling Height: 10 feet above top entrance level (maximum riser height 2 feet above entrance level).

Seating: 75 individual stations with table, 2 feet by 3 feet. 6 riser levels.

Figure 4-7
75-Student Classroom Using Projection Methods of Presentation.

d. The arrangement in Figure 4-8 is for platform lecture, screen projection, and television presentation.



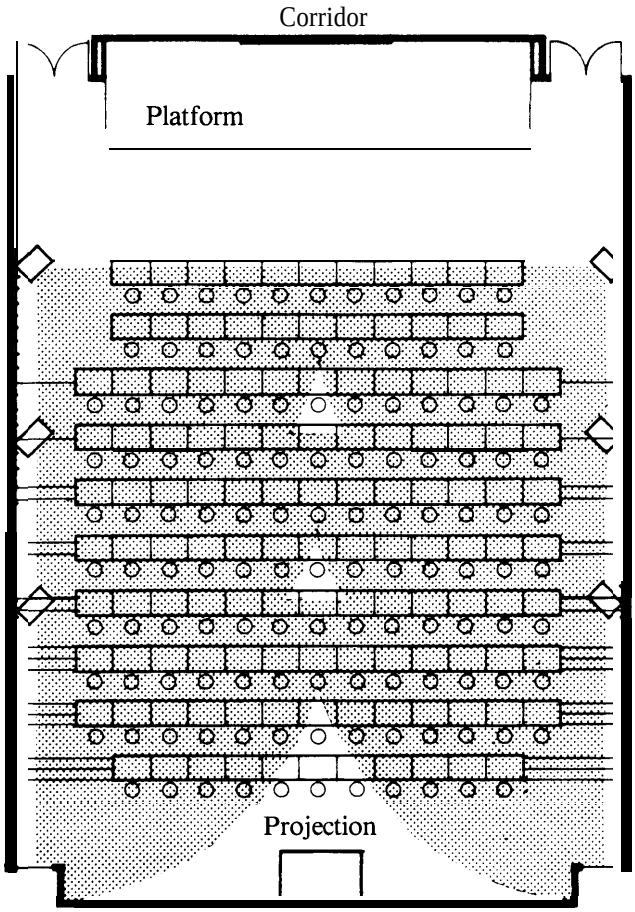
Dimension: 50 feet by 45 feet.

Ceiling Height: 8 feet above top seating level (seating level determined by minimum focal point elevation for viewing).

Seating: 75 individual stations with table, 2 feet by 3 feet. 5 riser levels.

Figure 4-8
75-Student Classroom Using Television Presentation Methods.

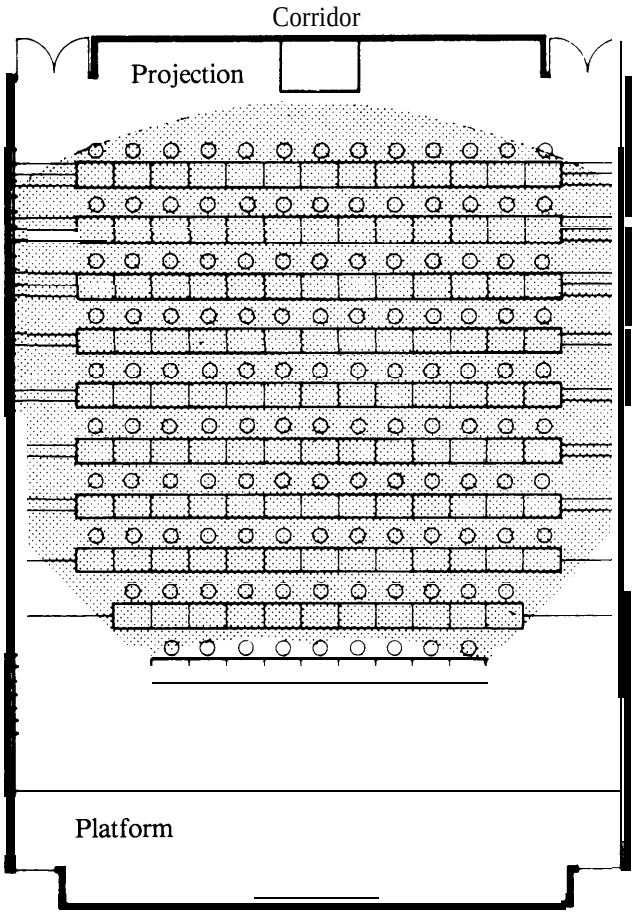
e. The arrangement in Figure 4-9 is for platform lecture, screen projection, and television A-V presentation. There is no exterior access directly into the room. Riser levels are all above the entrance level.



Dimension:	50 feet by 70 feet.
Ceiling Height:	8 feet above top seating level (seating level determined by minimum focal point elevation for viewing)
Seating:	125 individual stations with table, 2 feet by 3 feet. 8 riser levels.

Figure 4-9
125-Student Classroom Using Television Presentation Methods.

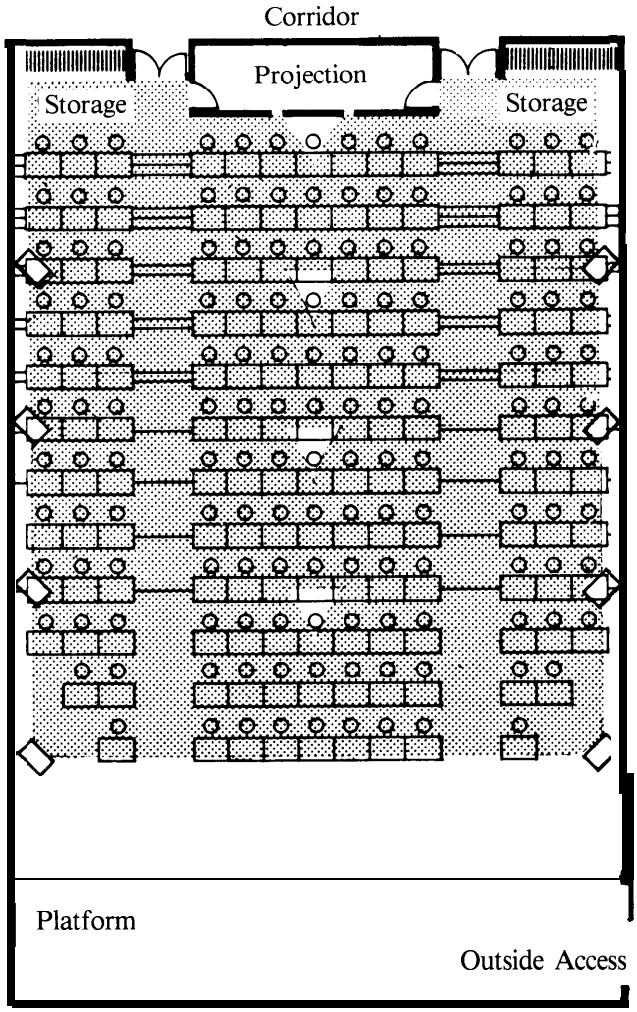
f. In Figure 4-10, the arrangement is similar to that of Figure 4-8; however, the floor is depressed from the entrance level. This allows integration of this large space with grade-level areas next to areas with 10-foot ceilings.



Dimension:	50 feet by 70 feet.
Ceiling Height:	8 feet above top seating level (minimum).
Seating:	125 individual stations with table, 2 feet by 3 feet. 8 riser levels.

Figure 4-10
125-Student Classroom Using Projection Methods of Presentation.

g. In Figure 4-11, the arrangement is for platform lecture, screen projection, television A-V presentation, and equipment demonstration with direct exterior access. Consider planning the room with the student entrance from a second-floor corridor and grading the exterior to provide an entrance for demonstration equipment at grade.



Dimension:	50 feet by 80 feet.
Ceiling Height:	8 feet above top seating level (minimum).
Seating:	150 individual stations with table, 2 feet by 3 feet. 9 riser levels.

Figure 4-11
150-Student Classroom.

h. The arrangement in Figure 4-12 is for platform lecture, screen projection, television A-V presentation, and equipment demonstration with direct exterior access. Consider planning the room with a second-floor student entrance and grading the exterior level up to the platform access point or with a first-level student entrance and grading the exterior level down to the platform access point. A space of this scale, requiring a 65-foot structural span, should be built as a single-story element.

Dimension:
65 feet by 90 feet.

Ceiling Height:
8 feet above top seating level (minimum).

Seating:
200 individual stations with table, 2 feet by 3 feet. 10 riser levels.

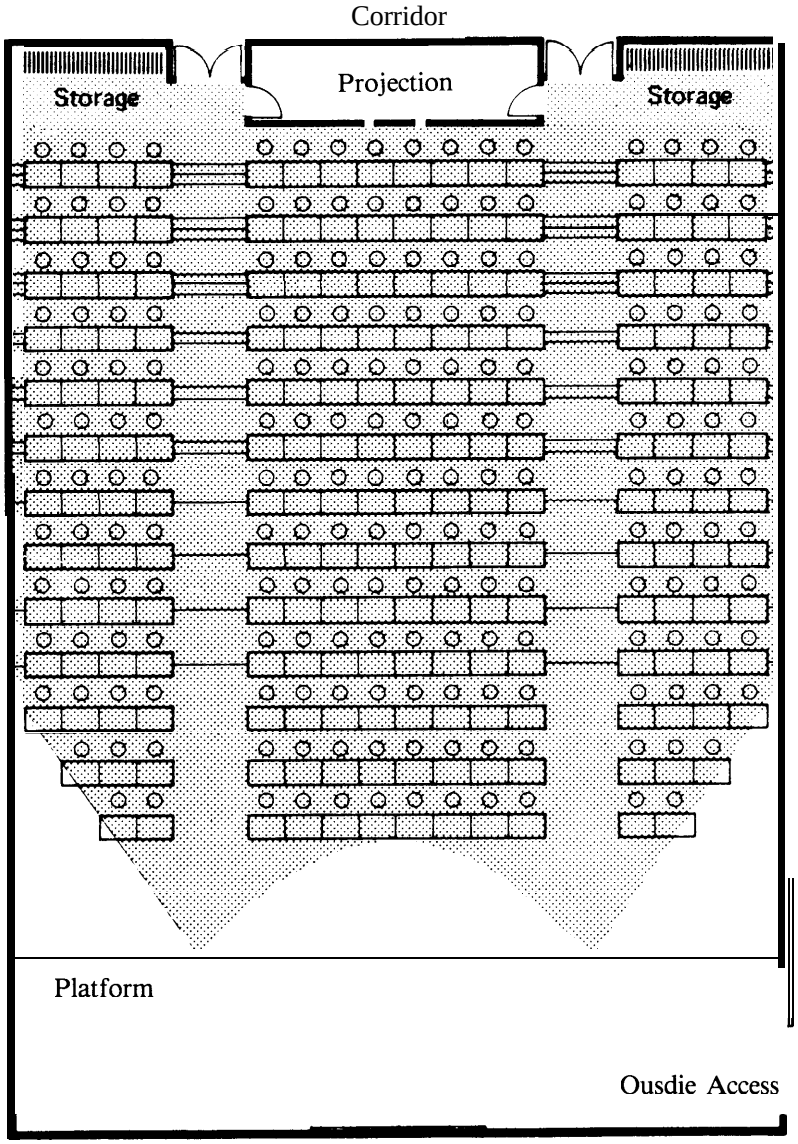


Figure 4-12
200-Student Classroom.

i. The arrangement in Figure 4-13 is for platform lecture, screen projection (portable screen) and television A-V presentation, and more specifically, large equipment demonstrations to one or both class areas. Student and equipment access is from grade level. Riser levels are all above entrance level.

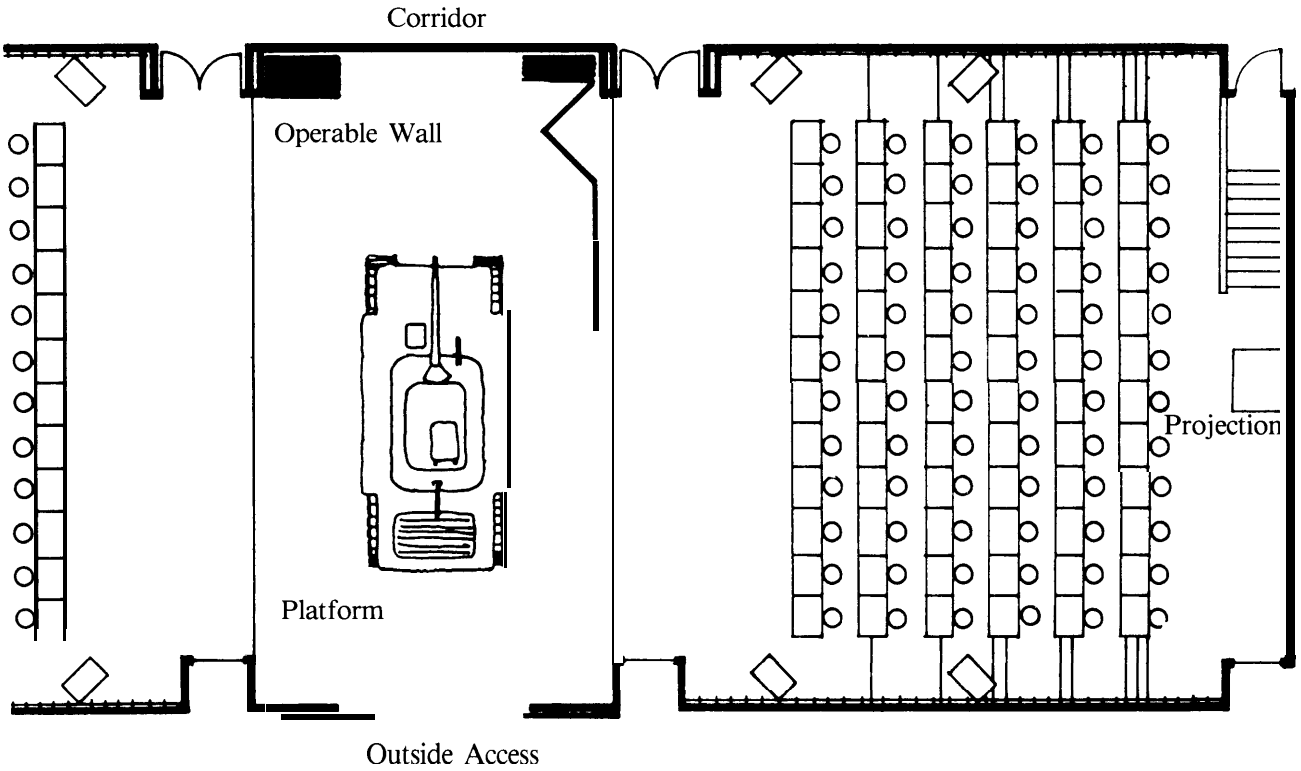
G. Electrical and Controls.

(1) There should be enough wiring to support all equipment used in classroom presentations or demonstrations, or for anticipated future use. Power and communication and electronic cables should be enclosed to minimize the need to string cables across the floor. Sufficient receptacles and jacks should be provided at convenient places in each classroom.

(2) Controls for lighting, A-V equipment, and sound systems should be located where the instructor can easily reach them. The preferred location for controls is at the front of the room where the instructor stands. In classrooms where a lectern is almost always used, a control panel built into the lectern may be desirable. Lighting controls provided for the instructor's convenience may be redundant to controls normally located near exits. However, dimming controls need only be included for the instructor.

H. Lighting.

(1) Daylight entering the room through windows must be controlled to minimize shadows, glare, and heat gain. During the day, artificial light should be used to



Dimension:	50 feet by 150 feet (two rooms, one equipment stage).
Ceiling Height:	8 feet above top seating level (seating level determined by minimum focal point elevation for viewing) and safe clearance for largest object for demonstration.
Seating:	70 individual stations with table, 2 feet by 3 feet. 5 riser levels.

Figure 4-13
70-Student Classroom.

supplement daylight. Daylight should be reflected into the room by overhands and light shelves; it should never be direct. Artificial (electric) light should be used to balance the level of daylight across the room depth. This requires controlling electric lights to respond to different levels of daylight illumination.

(2) Classroom lighting controls should be convenient to the instructor. General classroom artificial lighting should be zoned into levels of illumination to supplement daylighting. Incandescent task lights should be circuited for infinite light intensities of zero to full lamp wattage. Blinds or other daylight-omitting devices should be provided for use of A-V equipment. Lighting controls should be placed at the front of the room with A-V controls.

(3) Only occupied areas of a classroom need to be lighted. Light switches should control classroom zones. It is better to establish zones that extend across the room than the length of the room.

(4) There should be sufficient task lighting. Adjustable track or eyeball (spot/flood) lighting should be used to illuminate the instructor, classroom demonstrations, chalkboards, and other training aids.

I. Subdivided Classrooms.

The 24- and 50-student classrooms are developed within the typical module (paragraph 3-2b above) using a 30-foot-long structural span from corridor to exterior wall line. (Figures 4-4 and 4-5). Classrooms that hold more than 50 students will typically need spanning elements more than 30 feet long. (Room capacities are based on providing individual 2-foot by 3-foot desks at student stations.)

(1) Partitions should be placed so that furnishings and training equipment are available in each subspace, and room features and controls are accessible from within each subspace. Each subspace should have electrical, television, and sound receptacles and controls, chalkboards, and other items for training. Partitions should be placed between windows and lighting fixtures.

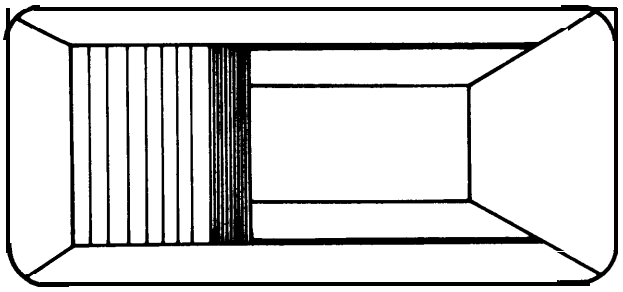
(2) Exits from a subspace must provide safe emergency egress and not disturb other subspaces. Each subspace must have an independent exit which opens directly into a corridor and does not pass through other subspaces. Most life safety standards consider operable walls, accordian-fold partitions, or a door in a partition between subspaces to be a second route of exit.

(3) Partition systems for subdividing large classrooms should be durable, easy to operate, and minimize sound transmission between subspaces. Partitions should have a sound transmission classification (STC) of 45 or greater. Seals around all edges (particularly along the floor and ceiling) are essential. (Figure 4-14).

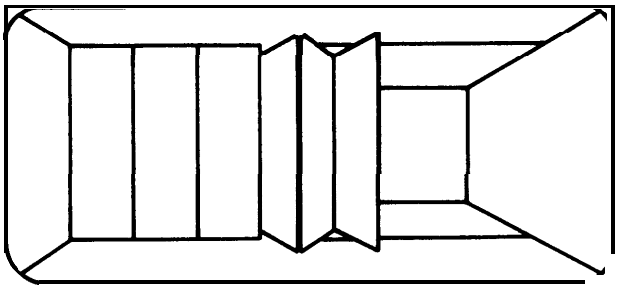
J. Furniture.

(1) Seating should be reasonably comfortable, but not so relaxing that it encourages inattentiveness (paragraph 3-3e above). Chairs with contoured seats and backs are more comfortable than those with straight seats and backs. The contours also keep the user facing forward because they cause discomfort when the user turns in other directions.

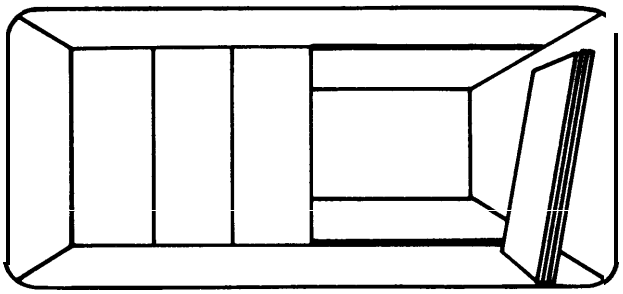
(2) Classroom furnishings should meet the needs of courses which use the classroom. The number of chairs, tables, or desks depends on the desired class size. The instructor's need to write material may be satisfied by products such as chalkboards, flipcharts, boards that use marker pens instead of chalk, electronic chalkboards, and overhead projectors with films that can be written on with wax pencil or special markers. The instructor's need to display papers and other visual aids may be satisfied by tackboards, tack strips along the top border of chalkboards, magnetic chalkboards, and special devices for hanging papers, maps, and charts. Some of these furnishings may be free standing and movable; others may be fixed to walls or hung from ceilings. (Figure 4-15).



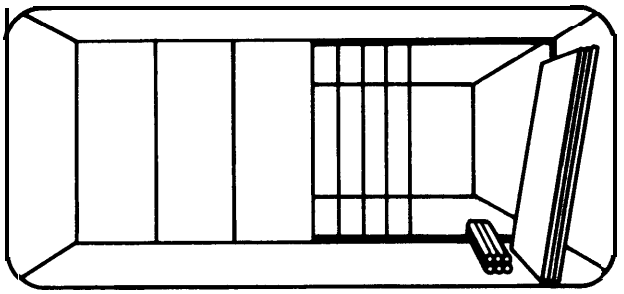
Operable Accordian Wall



Operable Stacking Panel Wall



Portable Panel



Movable Stud and Facing Panel Wall

Partition Type	Relative cost	Change Frequency			
		Hourly	Daily	Monthly	Yearly
Fixed (non-load bearing) 6" CMU 5" GWB	1	No	No	No	Yes
Moveable	1.8	No	No	Possible	Yes
Accordian	2.6	Yes	Yes	Yes	Yes
Portable	3.2	No	Possible	Yes	Yes
Folding Panel	5.4	Yes	Yes	Yes	Yes

Figure 4-14
Changeable Wall System.

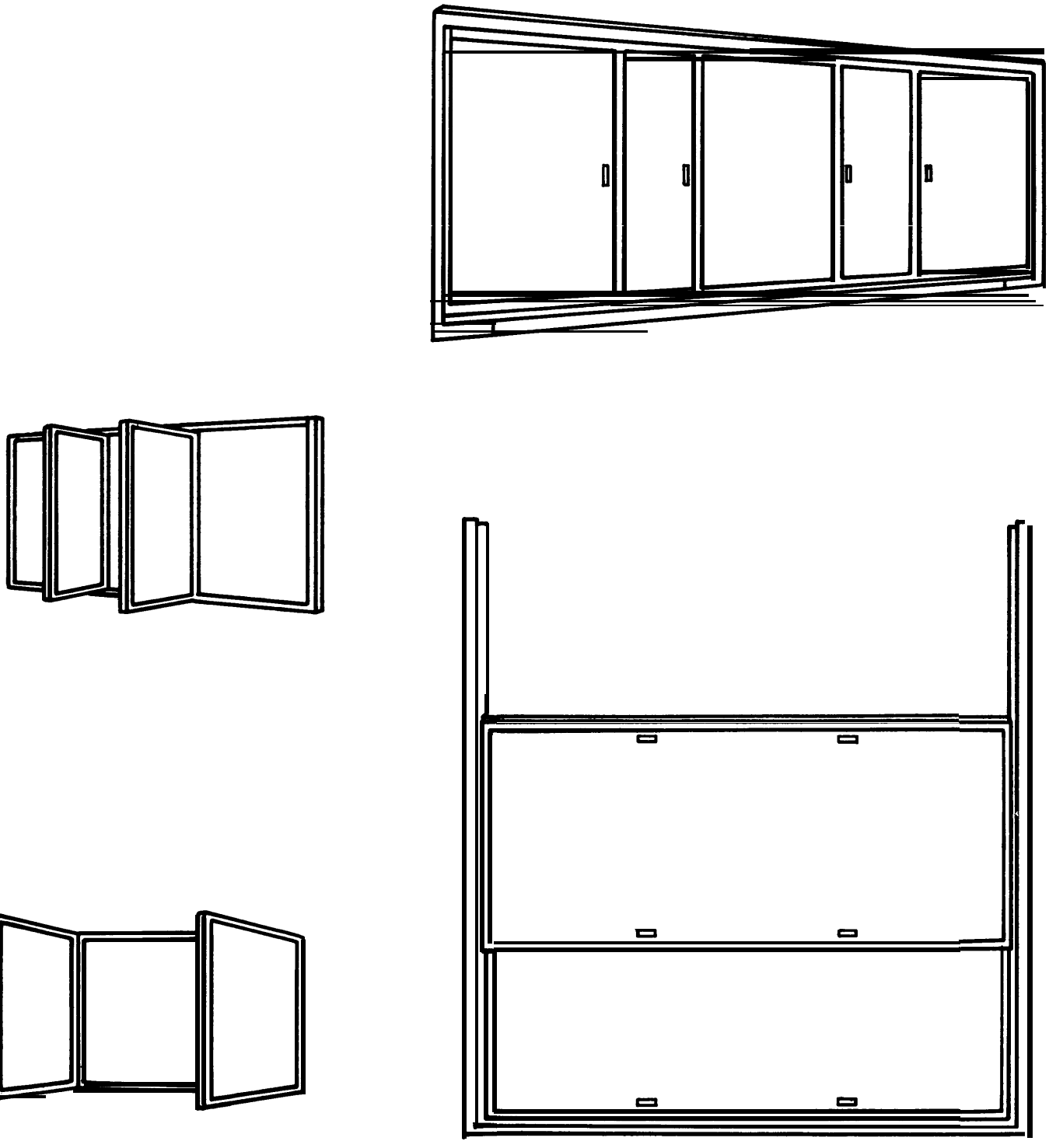


Figure 4-15
Examples of Chalkboards and Tackboards.

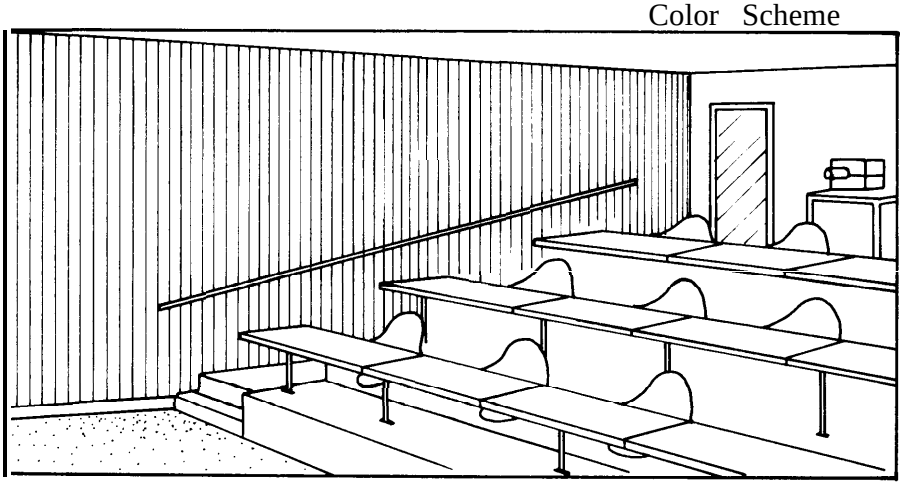
K. Interior Design.

(1) Finishes.

a. Floor should be attractive, easy to maintain, and functional. Although flooring materials can be used for sound control, final selection should include durability, wear, and ease of maintenance. Hard-surface flooring materials wear better, are less easily soiled, and are easier to clean; carpets and cushioned flooring have better sound control.

A		C	D	
a		b	a	b

Color Scheme



Interior Design Recommendations
Colors should be muted. Acoustical materials should be selected to coordinate with overall design scheme. Furniture and finishes should be durable for heavy use.

Room Finishes	
Item	Recommended Characteristics
Walls	Use light colors. Flat paint is recommended to minimize glare.
Floor	Hard surfaces are recommended for easy maintenance.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.

Furniture & Accessories	
Item	Recommended Characteristics
Seating	Chairs should be movable and comfortable.
Tables	Tables used by students should have laminated work surfaces with rounded or beveled endges.
Lighting	Spotlights should be used to accent the speaker and the demonstration areas.
Curtains	Blackout shades are recommended. Colors should coordinate with overall color scheme.

Figure 4-16
Interior Design Recommendations for Conference Classrooms.

Table 4-1 Criteria for Conference Classrooms.

Space Criteria	
Area/Student	25-35 s.f./student: based on seating with individual 2-ft. x 3-ft. desks, adequate circulation area, platform area (lecture or demonstration), A-V projection space and coat storage.
Ceiling Height	10 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Special Characteristics	Student sight lines are critical; depending on the size of audience and nature of the presentation, platforms for instructors and risers for seating may be required.
Seating Spacing	Reference: NFPA-101
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling), with each 750-s.f. class area having a thermostat.
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Chalkboard task lighting	50 fc. (maintained)
A-V lighting level	30 fc., reference: para 3-4f(2)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing wall sound rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Reflective
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 v
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

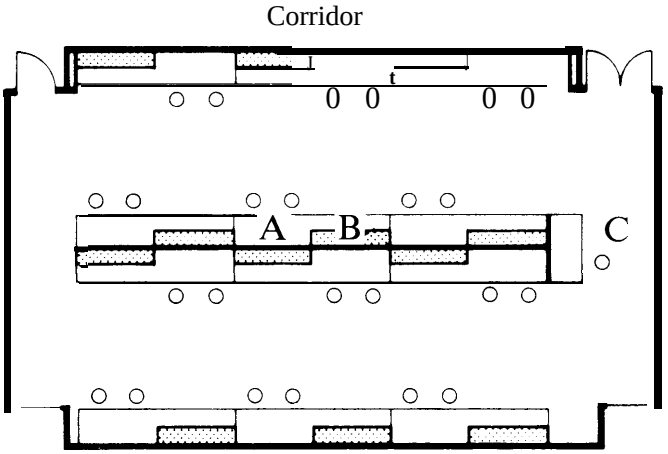
b. Interior finishes and colors should be selected to maintain acceptable levels of visual comfort (controlled reflectance properties and brightness ratios). Accepted methods of achieving visual comfort include painting ceilings, walls, woodwork, etc., to insure high light reflection; using matte rather than glossy paint; using satin rather than glossy wood finishes; using light-colored furniture and equipment; using light-colored tack- and chalkboards; using light-colored floors; having a multisource for daylight; making windows continuous; placing window heads flush with the ceiling; and using minimum-width window mullions.

(2) Recommendations.

a. For recommendations, see Figure 4-16. For example color schemes called out in the figure, see the Appendix.

b. For general guidance on interior design, see DG 1110-3-122.

L. Criteria.
Table 4-1 lists outline criteria for designing conference classrooms.



A Work Space
B Equipment
C Instructor

Figure 4-17
Laboratory Classroom With Group Stations.

4-3 Laboratory Classrooms.

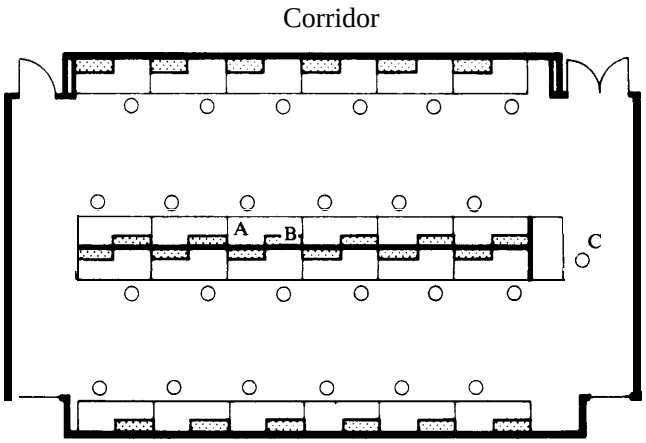
A. Use/Activities.
The main use of laboratory classrooms is for "hands-on" training on small equipment (paragraph 2-2g(3) above). In some schools, part of the instruction in laboratory classrooms will be devoted to a lecture. Then students will go to another part of the room to apply the lecture material "first-hand" to a model, mockup, training aid, or real equipment. The equipment can be a single object installed in the room and surrounded by circulation and instruction areas, or it may be groups of individual or paired student stations.

B. Occupants.
The instructor-student ratio will vary with each course, but is typically about the same as for laboratories and shop, i.e., between 1:20 and 1:40.

C. Equipment/Supplies.
Typical equipment is found in most laboratory classrooms. However, specific equipment and supplies for laboratory activities will vary widely.

D. Space Utilization.

(1) A laboratory classroom should have enough area for both laboratory and lecture instruction. About 45



A Work Space
B Equipment
C Instructor

Figure 4-18
Laboratory Classroom With Individual Stations.

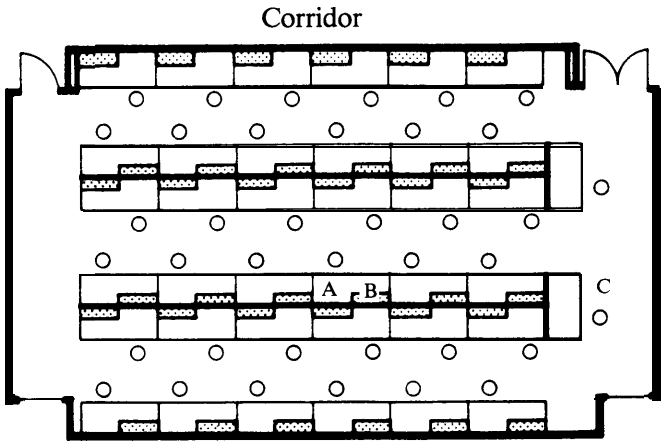
square feet should be allowed per student, but each room's needs will vary according to its equipment and the space required around it. The lecture area will require 25 to 35 square feet per student (see Section 4-2 above).

(2) The shape of the room must foster good use of space. In Figures 4-17 and 4-18 the layout shows grouped student stations placed for visibility toward room ends for display and instructor conference. Utilities for the groups should be provided to the backs of the stations from a single point overhead or through the floor. Laboratory classrooms are dedicated space to the extent that instruction is practically limited to using equipment in the space.

(3) The laboratories shown are contained in the standard classroom module, but any size that fits the school's structural system may be used since these are highly dedicated spaces. The standard laboratory casework may be planned on the 5-foot-square grid. When the nature of the work and length of the-class

b. For general guidance on interior design, see DG 1110-3-122.

G. Criteria.
Table 4-2 lists outline criteria for designing laboratory classrooms.



A Work Space
B Equipment
C Instructor

Figure 4-19
Laboratory Classroom for Standing Instruction.

allow, a 10-foot spacing between the centerlines of counters may be used for stand-up work. (Figure 4-19). When seats are required, a 15-foot spacing should be used as shown in Figures 4-17 and 4-18.

E. Access/Circulation.

(1) Location.
Laboratory classrooms should be clustered into suites containing space for apparatus storage, preparation of demonstrations, and lectures. (Figure 4-20 and paragraph 5-2 below).

(2) Circulation.
Aisles should provide ease of movement between the classroom and laboratory areas and around the laboratory equipment. It should be possible to move equipment in and out easily. Circulation in a laboratory classroom must meet the same life-safety criteria as classrooms. Special doors may be needed to move laboratory equipment in or out of the room. Enough space should be provided around laboratory equipment so students can see well and to insure that material movement does not create hazards.

F. Interior Design.

(1) Recommendations:

a. For recommendations, see Figure 4-21. For color schemes called out in the figure, see the Appendix.

4-4 Instructional Shops.

A. Use/Activities.
Instructional shops and laboratory spaces are enclosed spaces for conducting applied training in using and maintaining Army equipment. Laboratories generally refer to spaces where equipment is small and a number of similar workstations or work benches can be grouped into one room. Instructional shops generally refer to spaces for larger equipment and vehicles; students work in small groups or rotate among specialized locations. Because of this diversity, this guide cannot provide specific dimensional or loading criteria for laboratories/shops. However, the planning factors below pertain to shop design at all service schools .

B. Occupants.
The instructor-student ratio will vary between 1:40 and 1:20 or less.

C. Equipment/Supplies.
Most instructional shops house U.S. Army equipment for training use. Depending on the school, this equipment includes communication devices, computers, wheeled vehicles, artillery pieces, tracked and armored vehicles, guided missiles, and fixed and rotary-wing aircraft. Some shop areas house mockups instead of actual U.S. Army equipment items. These devices simulate, within a controlled environment, items of inventory equipment, especially field equipment. They are often made from parts of actual equipment and are partially operable; for example, the Armor School

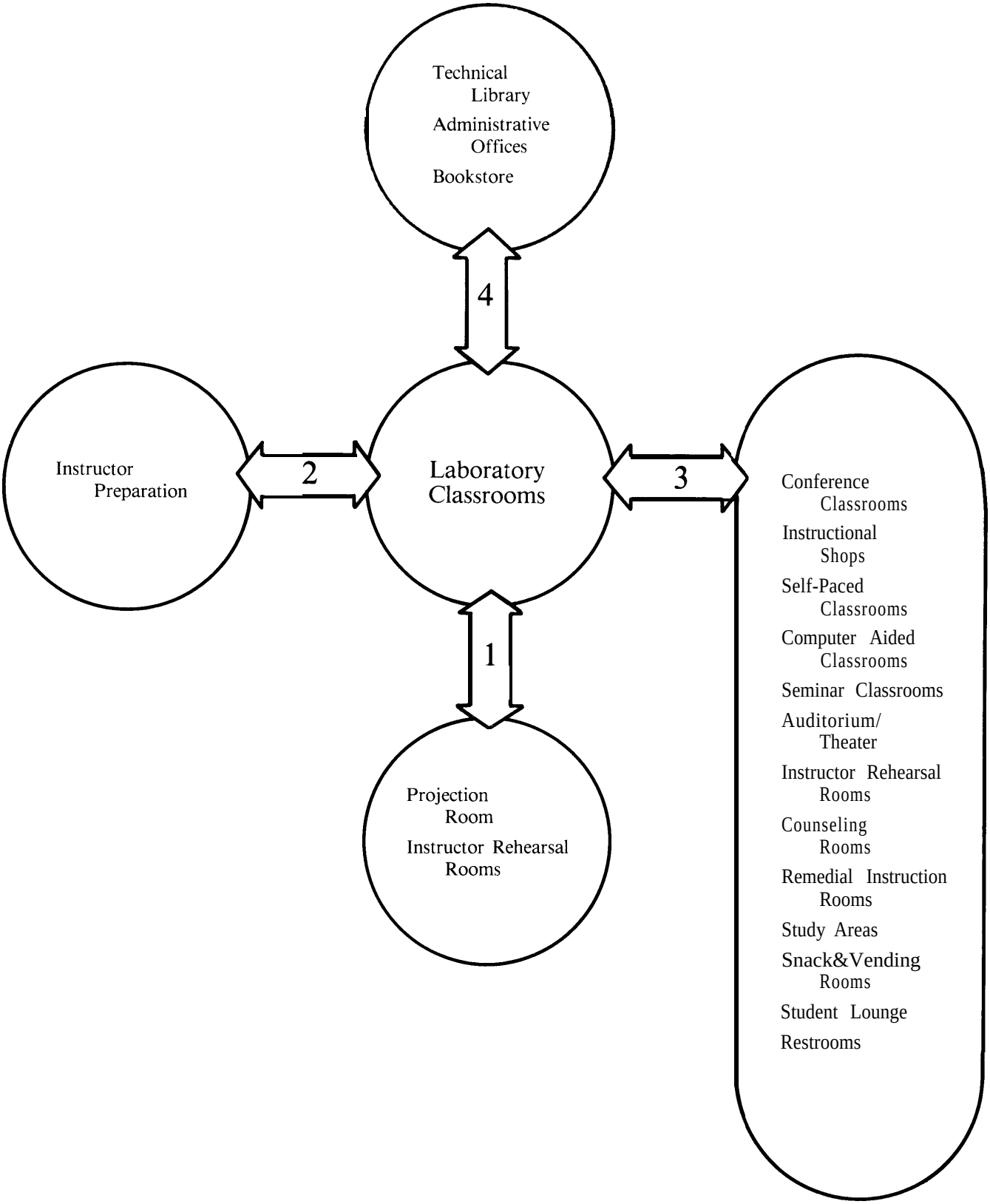
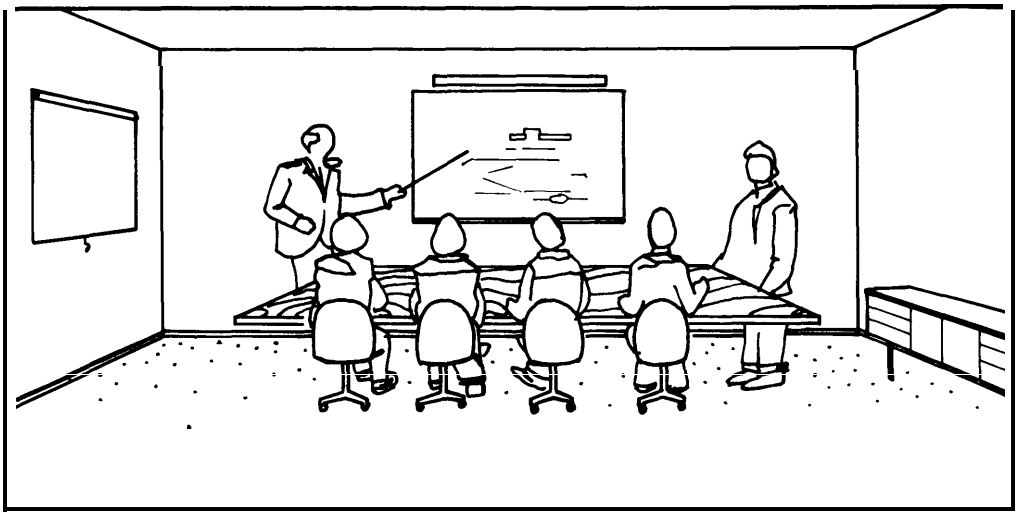


Figure 4-20
Spaces Near Laboratory Classrooms.

A			C	D	
a	b		a	b	a	b

Color Scheme



Interior Design Recommendations	
Room Finishes	
Item	**Recommended Characteristics**
Walls	Use flat paint in recommended colors or wallpaper corrdinated with the overall interior design scheme.
Floor	Use recommended carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.
Furniture & Accessories	
Item	**Recommended Characteristics**
Seating	Comfortable, upholstered chairs on casters should be provided.
Tables	Use laminated plastic or wood veneer.
Curtains	Blackout shades are recommended. Colors should coordinate with the overall color scheme.

Figure 4-21
Interior Design Recommendations for Laboratory Classrooms.

Table 4-2 Criteria for Laboratory Classrooms.

Space Criteria	
Area/Student	30-60 s.f./student
Ceiling Height	10 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum) (fumes, smoke potential, excessive heat may require up to 100% exhaust)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Negative
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Yes
Orientation of Windows	North or south
Acoustic	
Enclosing wall sound rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Walls:	Reflective
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

A Fire Protection
B Overhead Loading
C Special Exhaust
D Large Doors
E Equipment Movement
F Waste Utilities
G Large Equipment (fixed or moving)
H Student Stations

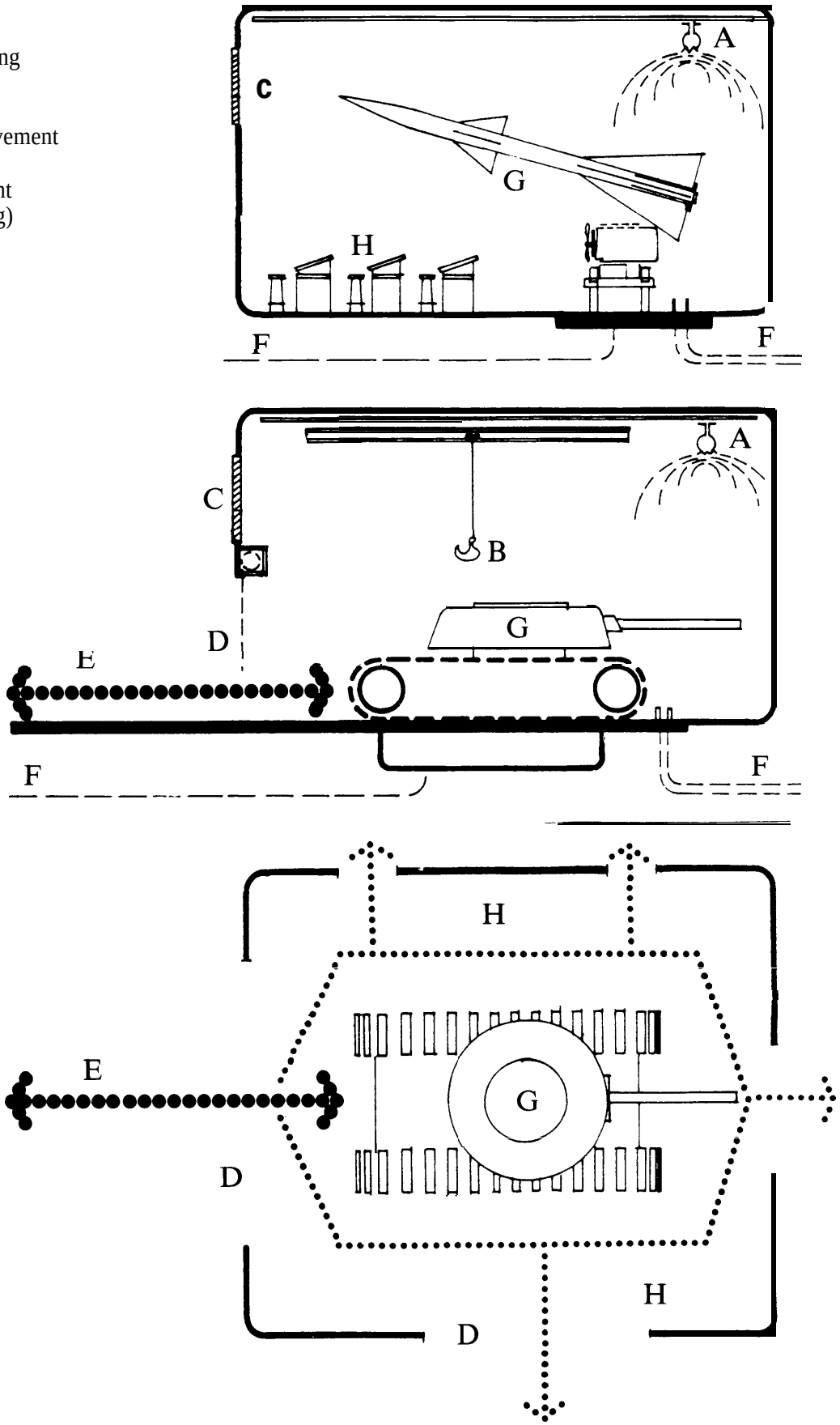


Figure 4-22
Design Considerations of Instructional Shop Spaces.

uses tank turrets mounted in shop areas to train personnel in aspects of tank gunnery and crew procedures. The same planning applies for both types of instructional shops. Spatial planning for both types of equipment must consider:

(1) Equipment Dimensions.

(2) Equipment Weight.

(3) Number of Equipment Items.

(4) Clearance for Movement of Equipment.

(5) Space Needed Around Equipment for Operation and Maintenance Training.

(6) Special Equipment, Controls, or Cable Limits.
Especially for mockup equipment, the spatial and mechanical/electrical requirements for devices which activate and control mockup equipment must be set. An example is special filtration and cleaning of air for laboratories/shops having optical or electrical equipment, general or local ventilation, or exhaust systems if fumes, smoke, other air contaminants, or excessive heat are present. (Figure 4-22).

D. Space Utilization.

(1) Size.
Teaching methods and student equipment should be carefully analyzed to determine how much laboratory space is needed. Standard space criteria are not set for this type of space because requirements vary with the subject matter being taught; this, in turn, determines the training devices, equipment, and aids to be used. The number of these items that will be used in the laboratory is determined by the student/equipment/ instructor ratios set for a course. Space requirements for each laboratory will be stated in terms of the size of training devices and equipment. They will include required floor area, ceiling and door height, power source, etc. Other space requirements include the amount of circulation space needed around each piece of equipment for its use and maintenance. (A general square foot estimate is 30 to 60 square feet per student and a ceiling height of 10 feet.) Movable partitions can be used to subdivide laboratory/shop space.

(2) Shape.
Whenever possible, the laboratory/shop should duplicate actual work setting. It may be hard to duplicate real work station and shop layouts in a school. Layouts should be checked to see if course goals and training methods are accommodated.

(3) Area Calculations.

a. Definitions.
A = Average number of students in each session.
B = Number of students assigned to each item of practice equipment or to each training aid.
C = Number of items of practice equipment or training aids required = $\frac{A}{B}$.
D = Square feet of floor area occupied by each item of practice equipment or each training aid (includes critical dimensions and clearances in all directions, safety requirements, aisles, and fire exits).
E = Square feet of floor area required for one student working on or around each item of practice equipment or each training aid.
F = Net square feet area of instructional laboratory.

b. Formula.
$[(B \times E) + D] \times C = F$.

c. Instructional Changes.
Add 20 percent allowance to F for instructional changes due to technology advances.

d. Graphic Layout.
A graphic layout should be made. The arithmetical square footage derived by the formula process can be deceiving; this is particularly so where circular or odd-shaped items of practice equipment and training aids are needed.

e. Human Engineering Factors.
Human engineering factors, including safety and lighting, should be considered at the start of the planning process.

E. Access/Circulation.
(Figure 4-23 and paragraph 5-2 below).

F. Storage.

(1) Size.
Shop areas with ample storage space should be provided. The amount of space required must be set for each school.

(2) Location.

a. Storage areas should be accessible to delivery vehicles. (Figure 2-10).

b. Storage areas should act as acoustic barriers between shops and other school activities. (Figure 5-4).

c. See paragraph 2-4c(2)(m) above for additional information on storage spaces.

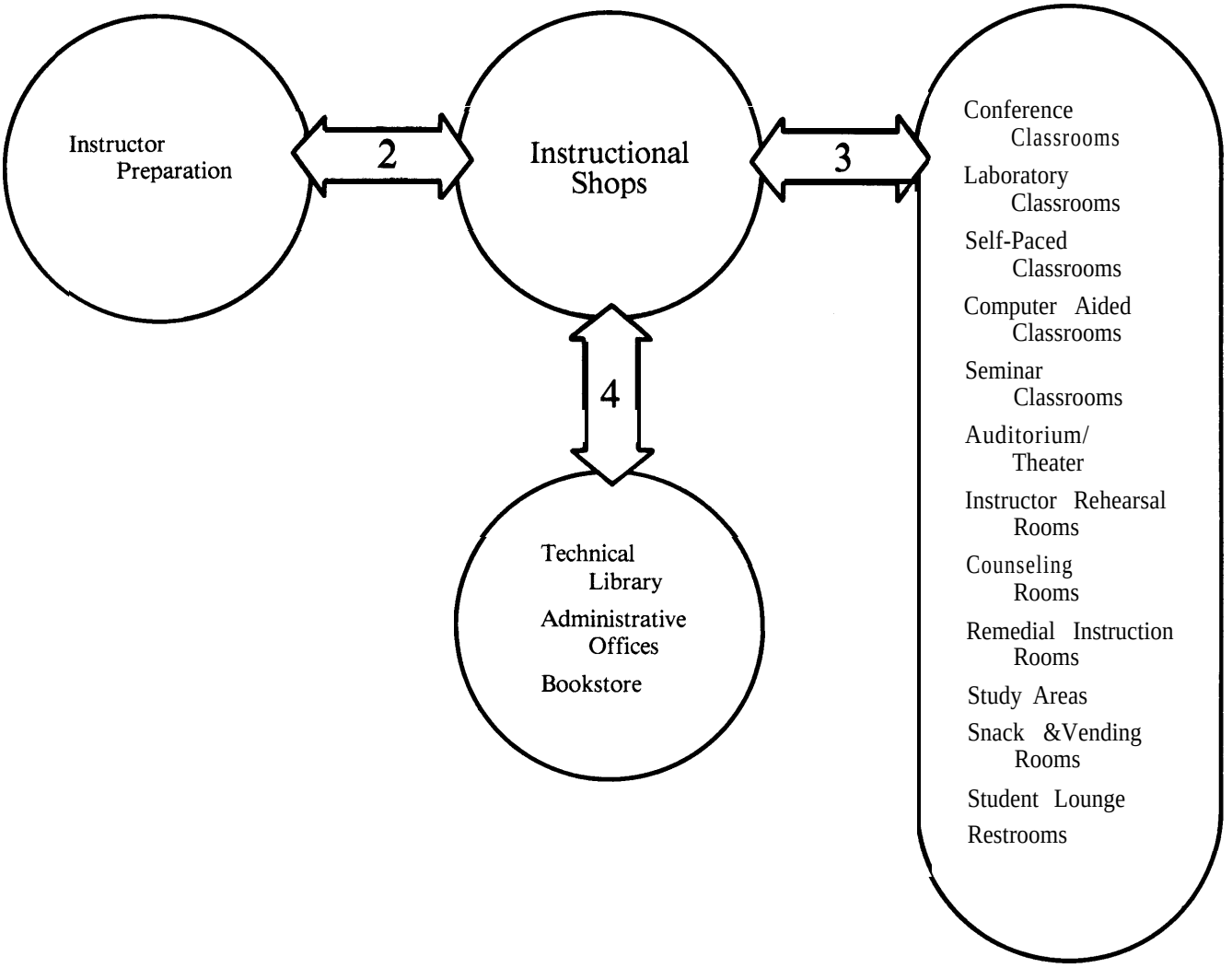


Figure 4-23
Spaces Near Instructional Shops.

(3) Openings and Access.

a. It should be easy to move equipment in and out of the laboratory/shop. Laboratories/shops which use vehicles or large equipment (i.e., that will not fit through a 3- or 6-foot-wide doorway) should have an overhead or track-mounted door. The door should allow direct entry to a shop from the outside.

b. A general circulation plan should be developed when buildings are changed for laboratories and shops. The advantages and disadvantages of outdoor and indoor routes should be compared. Outdoor routes require a drive and a door for each laboratory/shop area. Indoor routes may create vehicle-pedestrian traffic hazards and will use up space within the building; however, they will reduce the number of doors to the outside. Doors may increase energy use and ventilation for the building, depending on climate, laboratory/shop activities, and other factors.

c. General circulation among different spaces in the laboratory/shop should not disturb students who are working. A corridor or circulation route with training spaces on each side will reduce disturbances. Routes through training spaces should be avoided.

d. Floor systems should be designed to support expected heavy-equipment loads. When existing facilities are changed for laboratory/shop use, floor strength and other structural parts should be evaluated by a structural engineer to determine their capacity.

G. Furniture.
Furniture should be durable and easy to clean.

H. Interior Design.

(1) Finishes.
Walls and floors should be durable and easy to clean. Depending on laboratory/shop activities, surfaces may

need to be resistant to acids, alkaline material, greases, and solvents.

(2) Recommendations.

a. For recommendations, see Figure 4-24. For example color schemes called out in the figure, see the Appendix.

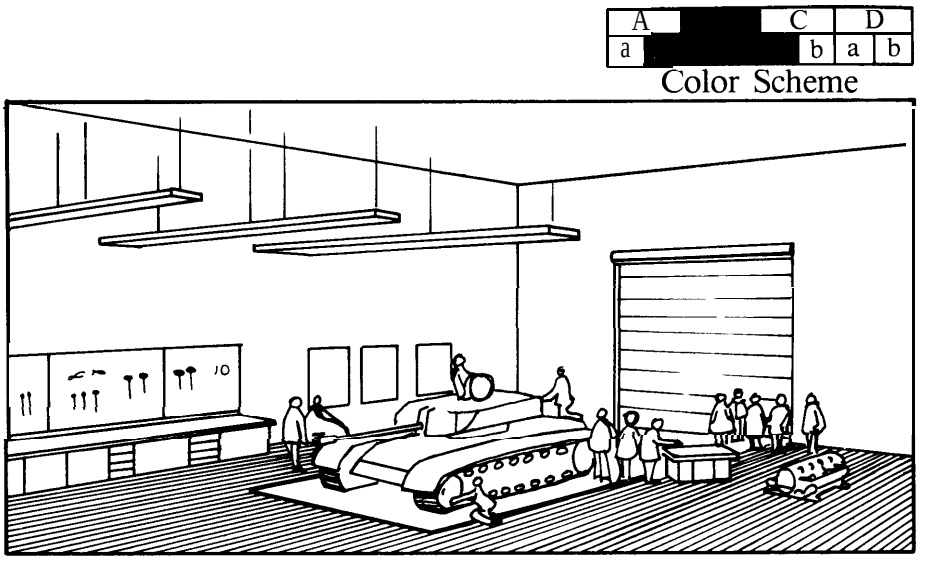
b. For general guidance on interior design, see DG 1110-3-122.

I. Criteria.

Table 4-3 lists outline criteria for designing instructional shops.

Table 4-3 Criteria for Instructional Shops.

Space Criteria	
Area	Reference: Paragraph 4-4d(2)
Environmental	
Thermal	
Temperature	65°F. (heating), mechanical ventilation for cooling
Outside air required/person	10 cfm (minimum)
Air changes	8 per hour (minimum)
Air pressure	Negative
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Daylighting	Yes
Window orientation	North or south
View in	No
Acoustic	
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Walls	Absorptive, NRC 25 (minimum)
Enclosing wall sound rating:	
Between shops and corridors	STC 40
Between shops and classrooms	STC 50
Service Criteria	
Electrical	
Power	110/ 120 V. Shops often require additional three-phase electrical power and 28 VDC for the simulated operation of equipment. The electrical conduit system serving shops should be designed so that additional power sources may be developed as required.



Interior Design Recommendations
Background colors should be muted. Brighter colors should be used for worktables or benches, seating, and trim. Caution or hazard areas should be clearly marked. Furniture should be movable for maximum flexibility.

Room Finishes	
Item	Recommended Characteristics
Walls	Painted concrete block or materials of similar durability should be used.
Floor	Hard, durable surfaces are recommended for easy maintenance and wearability.
Doors	Use durable hard wood or metal in recommended colors.
Trim	Use durable vinyl, hardwood, or metal in recommended colors.

Furniture & Accessories	
Item	Recommended Characteristics
Seating	Unupholstered, durable stools are appropriate.
Tables	Worktables with sturdy bases and replaceable wooden tops are recommended.
Lighting	Task lighting should be adjustable to provide flexibility.
Lockers	Metal locker units should be used if storage of student equipment or tools is required.

Figure 4-24
Interior Design Recommendations for Instructional Shops.

4-5 Self-Paced Instruction Rooms.

A. Use/Activities.
Self-paced instruction rooms allow students to master instructional material at their own rate. Students collect lesson materials from a control station, sit at an available carrel, and study, using A-V and written materials. Most self-paced instruction uses Training Extension Course (TEC) lessons. They consist of a pretest, viewing and listening to lesson topics, and a post-test. (TEC lessons may require the students to write.) After completing a lesson with an adequate performance level on the post-test, students return the TEC lesson to the control point and collect their next lesson. Each student is logged in and out by the classroom staff; the staff also maintains a progress chart on each student, verifies test performance, and monitors carrel activities. In some cases, the staff may give specific instructions to a group or to one person at a special carrel.

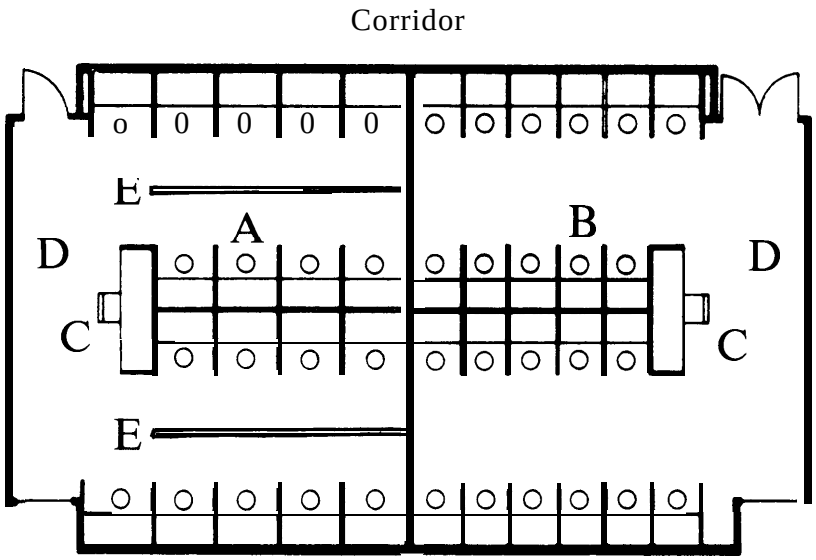
B. Occupants.
The number of students in this type of space can vary greatly. The upper limit is the number of carrels which can be monitored and managed from a control point. Some self-paced instructional spaces may be designed for only one or two students. Depending on program requirements, classroom staff typically will include instructors and clerks. Usually only one or two staff members will operate a control point.

C. Equipment/Supplies.
Self-paced instruction rooms contain special carrels equipped with A-V aids and a writing surface. The number of carrels in a room will vary with the student load. Power requirements and heat generated can be large when many carrels are together. Special carrels with demonstration, simulation, mockups, or other training aids may be needed. The staff area (control station) may include a desk, checkout counter, storage shelves for lesson materials, and files and racks for maintaining student progress charts.

D. Space Utilization.

(1) Size.
Self-paced instructional spaces should be sized to meet training objectives and provide for administration, service, storage, security, and custodial needs. Carrels will be used as stations for individual study or with group programs of instruction. In either case, the carrel may be a 4-foot by 3-foot position, suitable for reading material, or a 4-foot by 4-foot position, the minimum suitable for a unit that includes A-V aids.

(2) Arrangement.
Carrels shall be arranged to minimize distractions from room circulation patterns; they shall not be located along primary room circulation routes (Figure 4-25). A-V carrels require an acoustical separation on four sides; they should not be double-loaded on a single aisle. The minimum area required per A-V station is 32 square feet. Reading carrels may be grouped back-to-back on double-loaded aisles. The minimum area required per reading station is 25 square feet. About 200 square feet of space is needed for instruction, storage, and circulation.



A 4 Ft. A-V Carrels
B 3 Ft. Reading Carrels
C Instructor's Desk
D Primary Circulation
E Privacy Curtain

Figure 4-25
Instruction Carrels in Self-Paced Instruction Classroom.

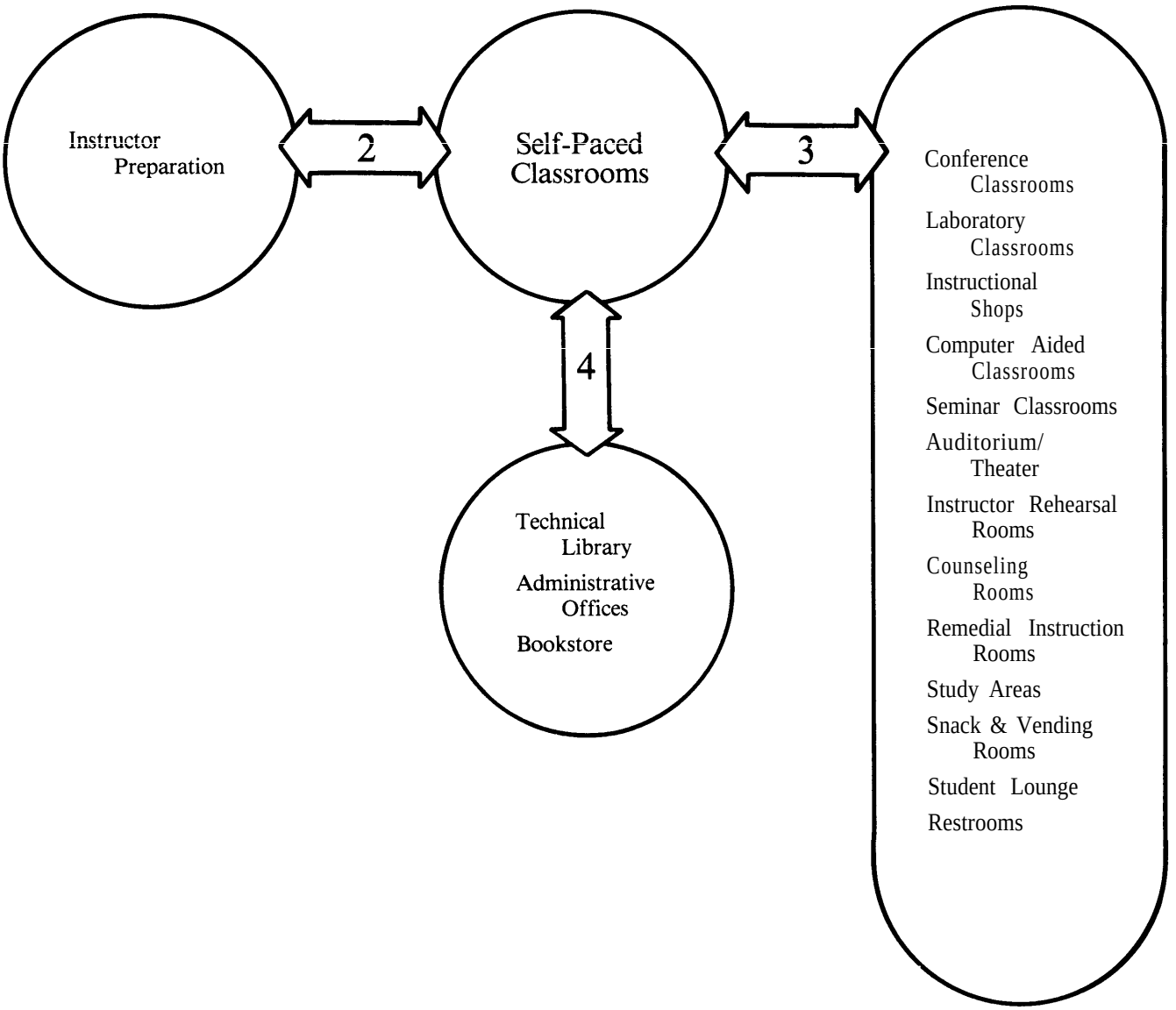


Figure 4-26
Spaces Near Self-Paced Instruction Rooms.

(3) Allocation.
There should be enough space for an instructor's desk, storage units for printed and A-V training material, and circulation. About 200 square feet will be needed for instructors and clerks, storage, and circulation around the control station.

E. Access/Circulation.

(1) Location.
Programs of instruction which combine self-paced and other forms of instruction in a coordinated manner should be located to best meet training goals. Self-paced instructional spaces should be near laboratories, shops, classrooms, or work areas as required by course plans. (Figure 4-26 and paragraph 5-2 below).

(2) Circulation Within Room.

a. Student distractions should be minimized. Carrels should not be in or near a room's primary circulation routes. Reading carrels can be double-loaded onto an aisle.

b. Instructors' desks and training material storage should be placed where they will ensure convenient log-in procedures or student acquisition of materials. Circulation routes from study carrels to exits should pass the control station; however, there should be enough space around the control station that traffic does not back up into the carrel area.

F. Utilities.
Electrical services are needed at carrels for audio-visual equipment and a slide viewer. Location and routing of electrical lines should allow for flexibility. Carrel equipment power demands should be analyzed carefully. Number of receptacles required at each carrel should be coordinated with the equipment expected to be used there, but typical carrel demands require three outlets per carrel.

G. Environmental Conditions.

(1) Lighting.
The general lighting level should be 30 foot-candles. Lighting levels in carrels should be 50 foot-candles. No task lighting is required if carrels do not have shelves mounted above the work surfaces. If shelves are mounted above the work surface, task lighting should be incorporated into the carrel design.

(2) Acoustic.
Acoustical control is essential to permit listening at normal conversational levels. Noise distractions from within and outside the room should be minimized. Control of noise from A-V equipment is very important. Audio-visual carrels require acoustical separation on all four sides. Acoustical panels between rows of carrels may also be needed. Ambient levels should not exceed 40 decibels; a continuous background noise level of 30 decibels is preferred. Carpets and acoustical ceiling material are recommended to control noise. Walls between rooms should have an STC rating of 45. Walls between self-paced instructional rooms and corridors should have an STC rating of 40.

(3) Thermal.

a. Waste heat from A-V and other equipment may need to be removed. Carrels should be designed to allow air circulation along the floor. Carrel panels should be at least 8 inches from the floor.

b. Certain types of training programs may require interconnections between carrel equipment and an instructor station, computer, or other locations. Space should be provided for cable and power wiring runs.

H. Storage.
Self-paced instruction rooms and carrels should have space for students' personal belongings. Each carrel should have a bookshelf or book rack for study materials.

I. Furniture.

(1) Carrels containing frequently used or highly specialized equipment or materials may be dedicated.

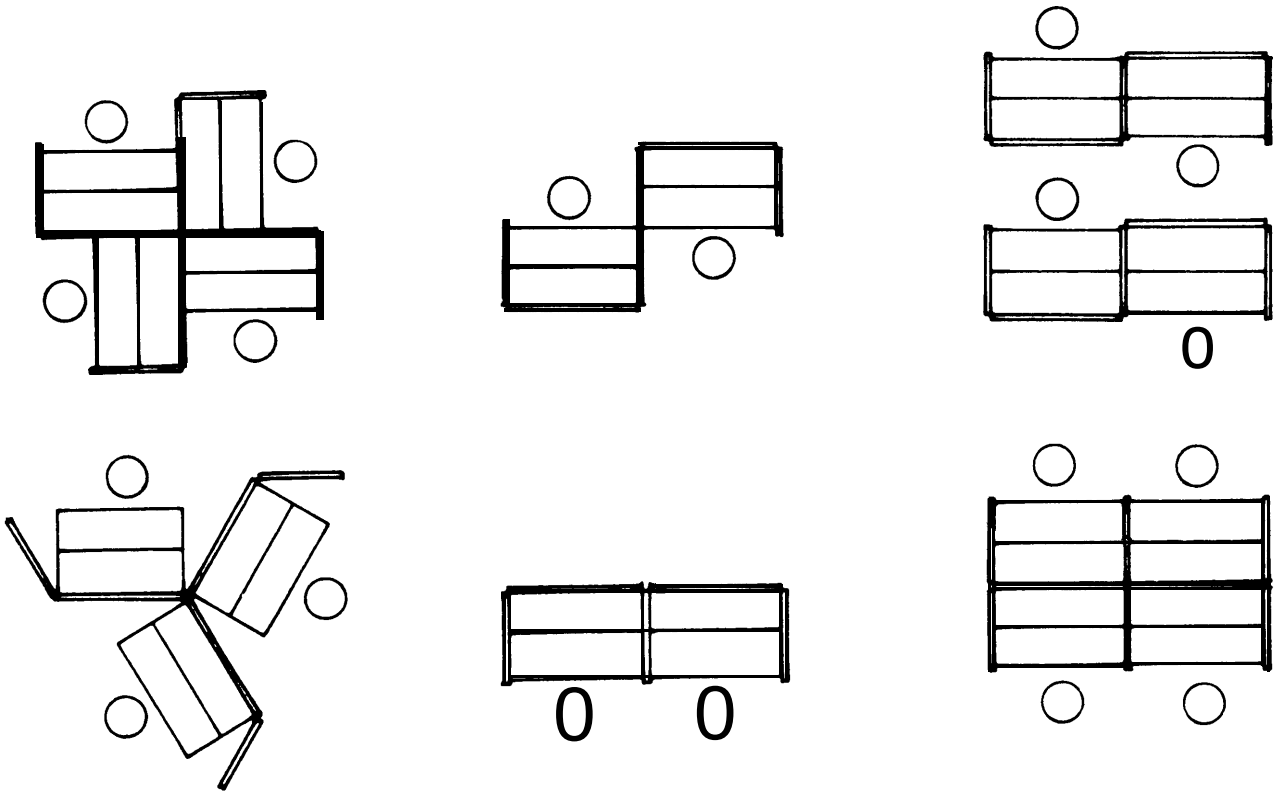
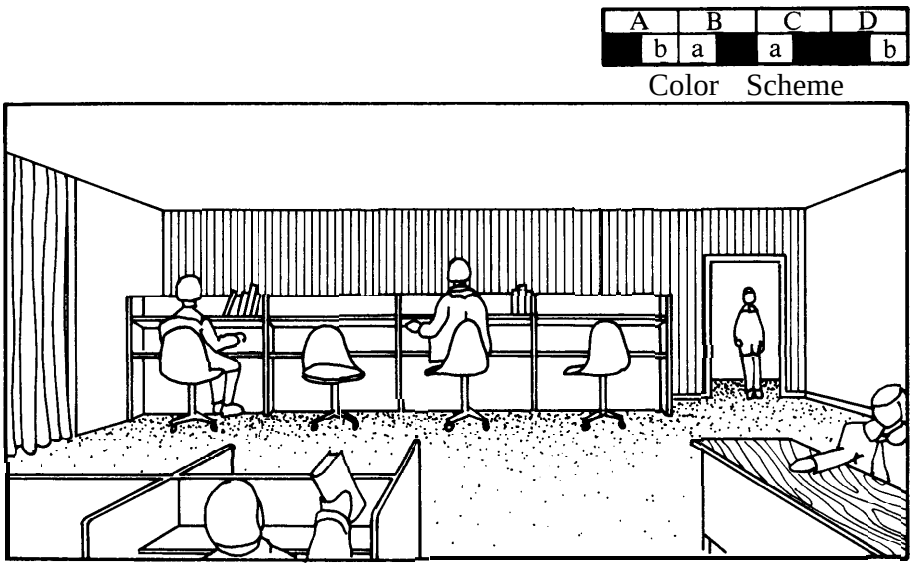


Figure 4-27
Carrel Layouts.



Interior Design Recommendations	
Physical, visual, and auditory comfort are very important in self-paced instruction rooms. The total environment should be conducive to study.	
Room Finishes	
Item	**Recommended Characteristics**
Walls	Use flat paint to reduce glare or wallcoverings coordinated with the overall interior design scheme.
Floor	Use recommended carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.
Furniture & Accessories	
Item	**Recommended Characteristics**
Seating	A comfortable upholstered, swivel chair on casters is recommended for each carrel.
Lighting	Lighting needs to be carefully designed to meet the task requirements of this room. Glare and over-lighting need especially to be avoided.
Carrels	Use laminated plastic or wood veneer.
Curtains	Open weave curtains are recommended to limit direct sunlight. Colors should coordinate with the overall color scheme.

Figure 4-28
Interior Design Recommendations for Self-Paced Instructional Classrooms.

Otherwise, carrels should be suitable for using a variety of equipment and devices.

(2) Carrels must be designed to meet learning objectives, training tasks, and equipment requirements. Reading carrels should be 2 by 4 feet (minimum). Reading carrels should be grouped back-to-back or in clusters. Audio-visual carrels should be 2 l/2 by 4 feet (minimum); this may vary with the type of A-V equipment being used and the need for a writing surface. Carrels with A-V aids require acoustical separation on all four sides. (Figure 4-27).

J. Interior Design.

(1) Finishes.
The reflectance level of carrel surfaces should be minimal. Surface reflectance should not exceed 35 to 50 percent.

(2) Recommendations.

a. For recommendations, see Figure 4-28. For example color schemes called out in the figure, see the Appendix.

Table 4-4 Criteria for Self-Paced Instruction Classrooms.

Space Criteria	
Area/Student	
Hot (wired) carrels	32 s.f.
Reading carrels	25 s.f.
Ceiling Height	9 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task-carrel lighting level	50 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing wall sound rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V; 330 volt-amperes per carrel (minimum)
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

b. For general guidance on interior design, see DG 1110-3-122.

K. Criteria.
Table 4 lists outline criteria for designing self-paced instruction classrooms.

4-6 Computer-Aided Instruction Rooms.

A. Use/Activities.
Computer-based instruction rooms allow students to master instructional material at their own rate using either computer presentation/simulation or computer presentation and training aids (mockup or other). Students collect lesson materials from a control station, sit at an available carrel, and study. Most computer-based instruction uses post-test lessons. After completing a lesson with an adequate performance level on the post-test, students return the lesson to the control point and collect their next lesson. Each student is logged in and out by the classroom staff; the staff also maintains a progress chart on each student, verifies test performance, and monitors carrel activities. In some cases, the staff may give specific instructions to a group or to one person at a special carrel.

B. Occupants.
The number and age of user in this type of space can vary greatly. The upper limit is the number of carrels which can be monitored and managed from a control point. Some computer-based instructional spaces may be designed for only one or two students. Classroom staff will typically include instructors and clerks, depending on program requirements. Usually, only one or two staff members will operate a control point.

C. Equipment/Supplies.
Computer-based instruction rooms contain special carrels equipped with interactive, video-disk microcomputer units, plato terminals, or microcomputer alone. The number of carrels in a room will vary with student load. Power requirements and heat generated can be large when many carrels are located together. Special carrels with demonstration, simulation, mockups, or other training aids may be needed. The staff area (control station) may include a desk, checkout counter, and storage shelves for lesson materials.

D. Space Utilization.

(1) Size.
Computer-based instruction spaces should be sized to meet training objectives and provide for administration, service, storage, security, and custodial requirements. Carrels will be used as stations for individual study or with group programs of instruction. In either case, the carrel may be a 5-foot by 2-1/2 foot rectangular position (the minimum suitable for a unit that includes a microcomputer with terminal) or an angular type. (Figures 4-29 and 4-30).

(2) Arrangement.
Carrels shall be placed to minimize distractions from circulation patterns in the room; they shall not be located along primary room circulation routes. (Figure 4-25). Audio-visual carrels require an acoustical separation on four sides and should not be double-loaded on a single aisle. The minimum area needed per computer station is 23 square feet.

(3) Allocation.
There should be enough space for an instructor's desk, storage units for printed and A-V training material, and circulation. About 200 square feet will be needed for instructors and clerks, storage, and circulation around the control station.

E. Access/Circulation.

(1) Location.
Programs of instruction which combine computer-based and other forms of instruction in a coordinated manner should be located to best meet training goals. Computer-based instructional spaces should be near laboratories, shops, classrooms, or work areas as required by course plans. (Figure 4-31).

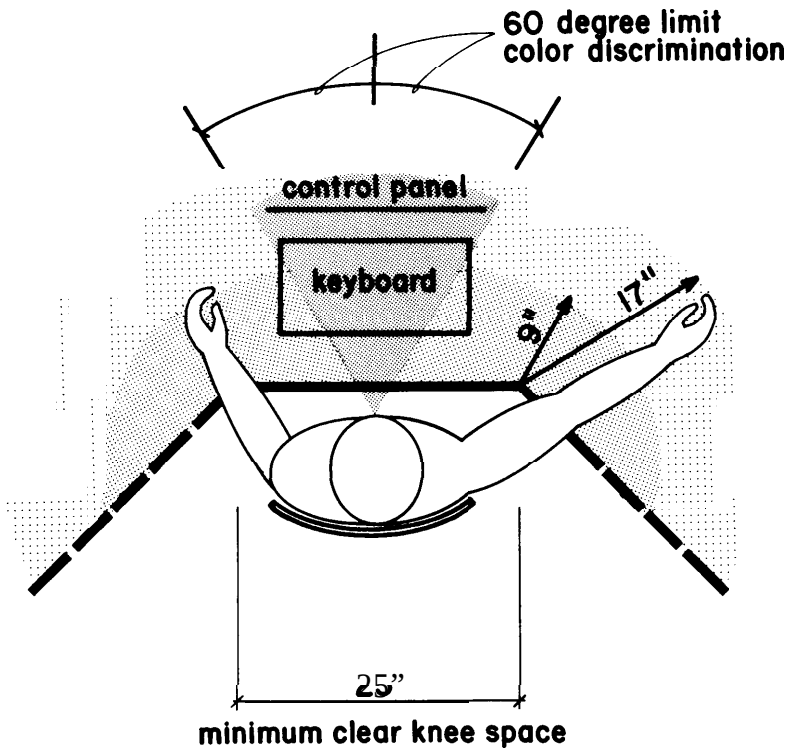
(2) Circulation Within Room.

a. Student distractions should be minimized. Carrels should not be in or near a room's primary circulation routes. Reading carrels can be double-loaded onto an aisle.

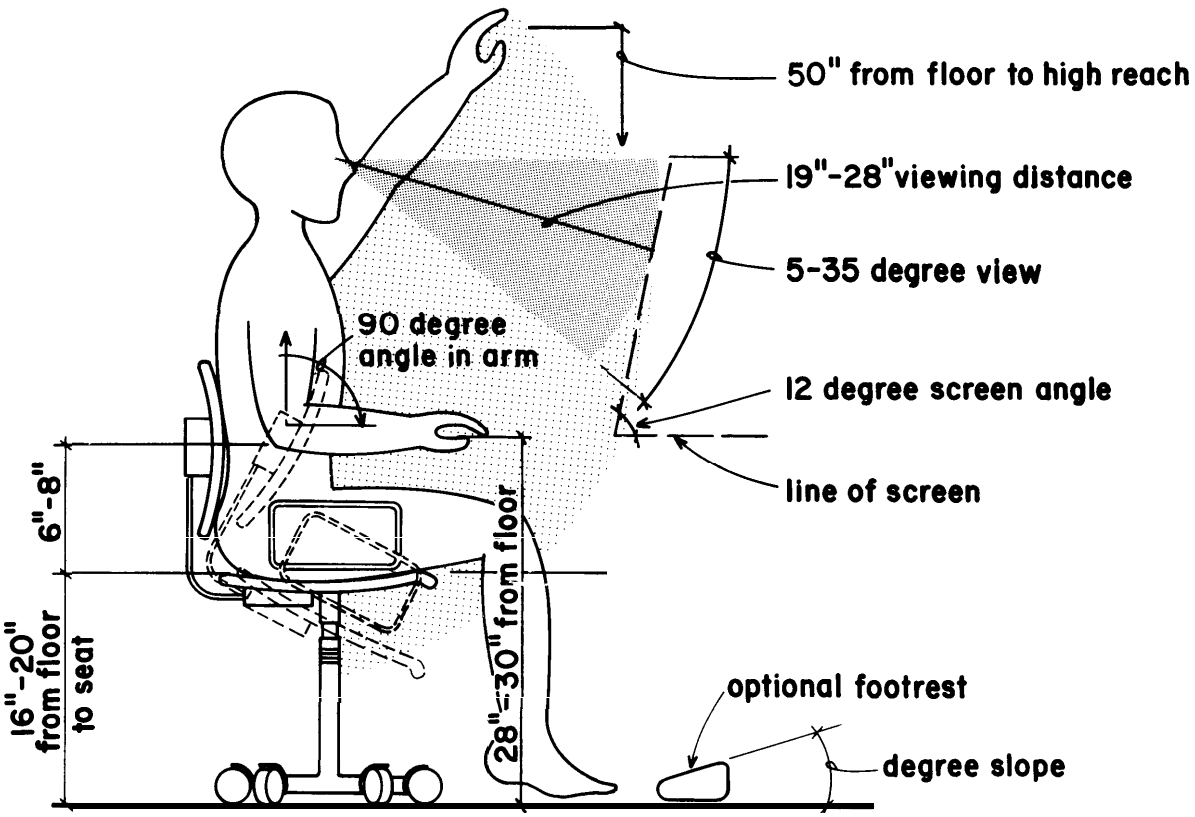
b. Instructor's desks and training material storage should be placed where they will insure convenient log-in procedures or student acquisition of materials. Circulation routes from computer carrels to exits should pass the control station; however, there should be enough space around the control station so that traffic does not back up into the carrel area.

F. Utilities.

(1) Electrical Wiring.
Electrical services are needed at carrels for microcomputers and peripheral equipment. Location and routing of electrical lines should allow for flexibility. Carrel equipment power demands should be analyzed carefully. Number of receptacles required at each carrel should be coordinated with the equipment expected to be used there, but typical carrel demands require three outlets per carrel.

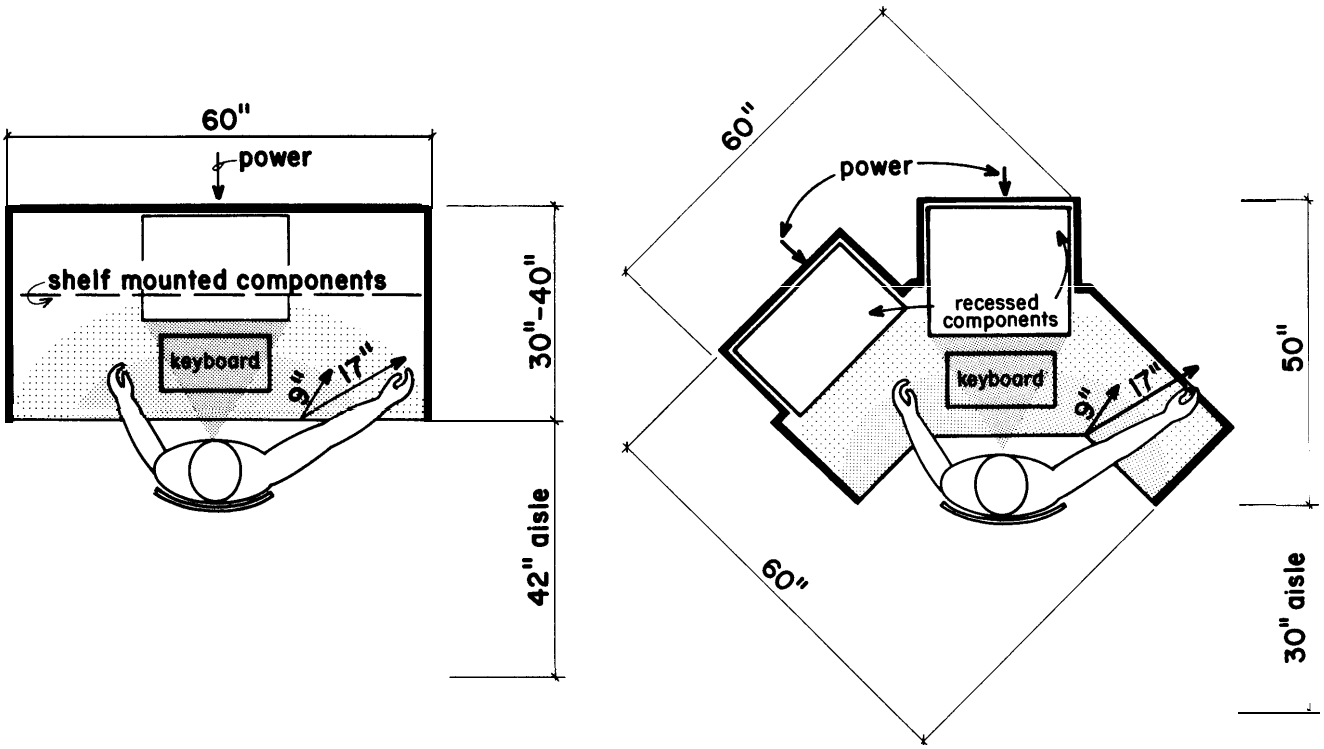


Plan View

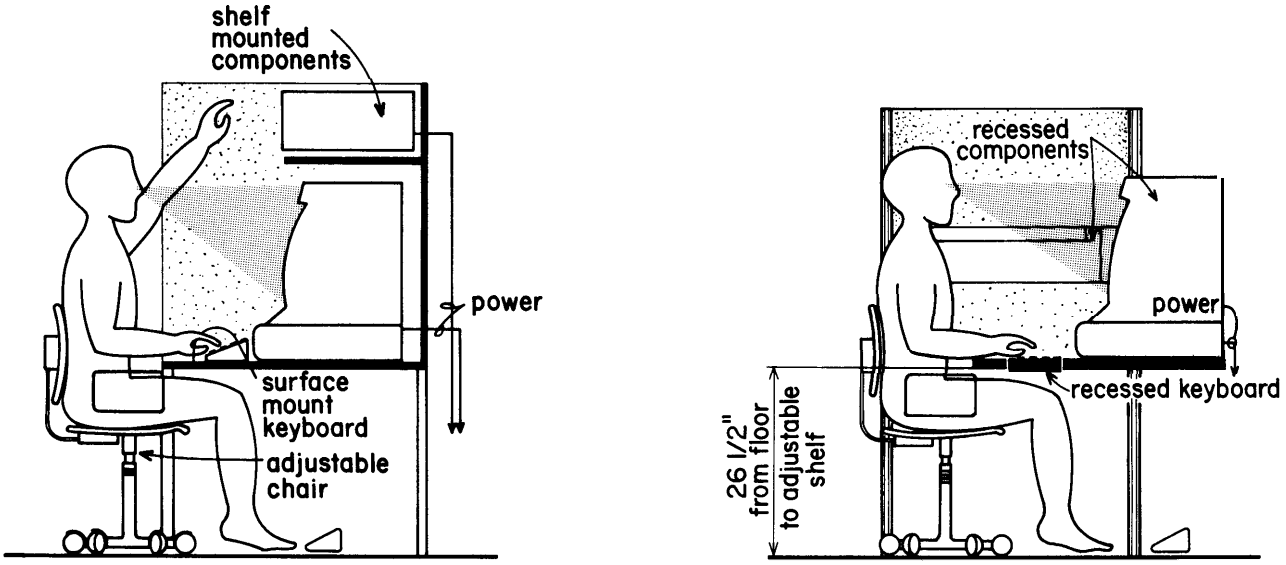


Side View

Figure 4-29
Human Design Factor Dimensions for
Computer-Aided Instruction Carrels.



Plan View



Sectional View

Figure 4-30
Comparison of Angular and Rectangular Carrels.

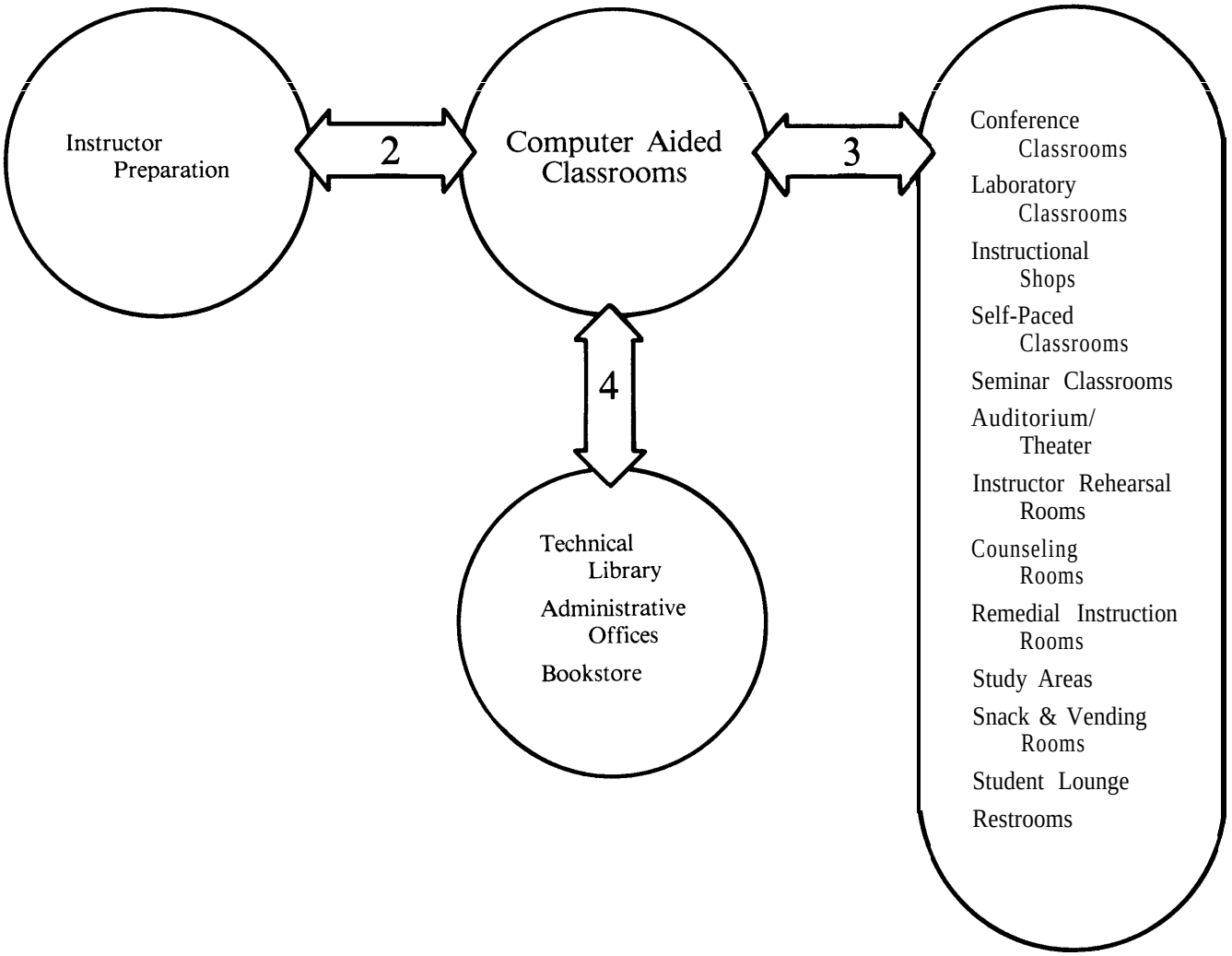


Figure 4-31
Spaces Near Computer-Aided Instructional Classrooms.

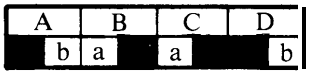
(2) Surge Protection.
Electrical power to classrooms using microcomputer-based instruction should be protected from surges in electrical voltage by a lightning arrester/surge protector. Surge protection may be incorporated in the electrical line filter. Microcomputers in instruction classrooms should not be supplied by electrical circuits which also supply power for electrical motors or electrical devices which automatically cycle on or off (such as coffee pots, photocopy machines, etc.).

(3) Standby Power.
Electrical power to classrooms using microcomputer-based instruction may need to be protected from sags or drops in electrical voltage by the use of standby power sources. Such protection is only needed when individual microcomputers will be used for extremely long tasks using data that would be difficult to replace if lost.

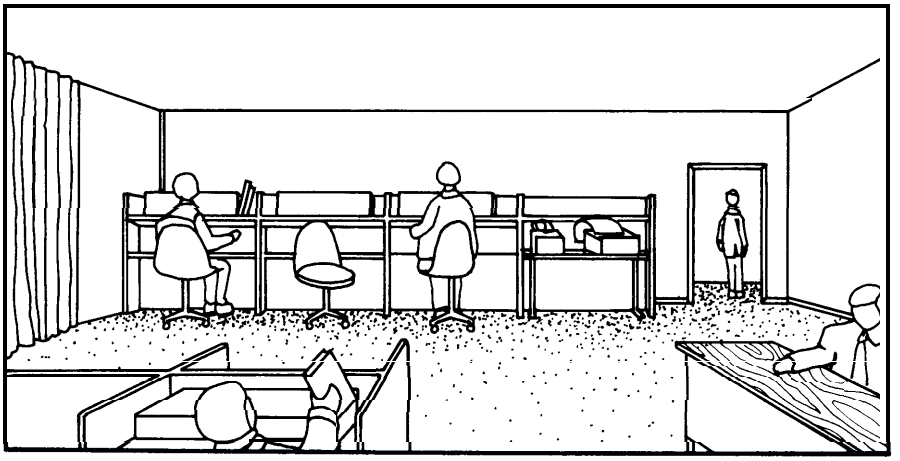
(4) Electrical Line Filtering.
Electrical power to classrooms using microcomputer-based instruction should be protected from interference by an electrical line filter. The line filter may incorporate the surge protector. Computers may have individual line filters. Filters may be for grouped computers, or the entire circuit for all microcomputers in the classroom may be protected.

G. Environmental Conditions.

(1) Lighting.
The general lighting level should be 30 foot-candles. Lighting levels at carrels should be 50 foot-candles. No task lighting is required if carrels do not have shelves mounted above the work surfaces. If shelves are mounted above the work surface, task lighting should be incorporated into the carrel design.



Color Scheme



Interior Design Recommendations	
Physical, visual, and auditory comfort are very important in computer-aided instruction rooms. The total environment should be conducive to study.	
Room Finishes	
Item	**Recommended Characteristics**
Walls	Use flat paint to reduce glare or wallcoverings coordinated with the overall interior design scheme.
Floor	Use recommended static free carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.
Furniture & Accessories	
Item	**Recommended Characteristics**
Seating	A comfortable upholstered, swivel chair on casters is recommended for each carrel.
Carrels	Use laminated plastic or wood veneer.
Lighting	Lighting needs to be carefully designed to meet the task requirements of this room. Glare and over-lighting need especially to be avoided.
Curtains	Open weave curtains are recommended to limit direct sunlight. Colors should coordinate with the overall color scheme.

Figure 4-32
Interior Design Recommendations for Computer-Aided Instructional Classrooms.

(2) Acoustics.
Acoustical control is essential to permit listening at normal conversational levels. Noise distractions from within and outside the room should be minimized. Control of noise from A-V equipment is very important. A-V carrels require acoustical separation on all four sides. Acoustical panels between rows of carrels may also be needed. Ambient levels should not exceed 40 decibels; a continuous background noise level of 30 decibels is preferred. Carpets and acoustical ceiling material are recommended to control noise. Walls between rooms should have an STC rating of 45. Walls between self-paced instructional rooms and corridors should have an STC rating of 40.

(3) Thermal.
Waste heat from computer and other equipment will need to be removed. Carrels should allow air circulation along the floor. Carrel panels should be at least 8 inches from the floor.

H. Storage.

(1) Each interactive video-disk microcomputer will have a storage case. Storage cases for all interactive video-disk microcomputer units should be close to their point of use. Each storage case requires about 14 cubic feet of storage space.

(2) Self-paced instruction rooms and carrels should accommodate students' personal belongings. Each carrel should have a bookshelf or book rack for study materials.

I. Furniture.

(1) Carrels containing frequently used or highly specialized equipment or materials may be dedicated. Otherwise, carrels should be suitable for using a variety of equipment and devices.

(2) Carrels must be designed to meet learning objectives, training tasks, and equipment requirements. Computer carrels should be 5 by 2 1/2 feet (minimum for rectangular); this may vary with the type of computer equipment used and the need for a writing surface. Reading carrels should be grouped back-to-back or in clusters. Carrels with A-V aids require acoustical separation on all four sides.

J. Interior Design.

(1) Finishes.
The reflectance level of carrel surfaces should be minimal. Surface reflectance should not exceed 35 to 50 percent.

(2) Recommendations.

a. For recommendations, see Figure 4-32 and 5-2. For example color schemes called out in the figures, see the Appendix.

b. For general guidance on interior design, see DG 1110-3-122.

K. Criteria.
Table 4-5 lists outline criteria for designing computer-aided instruction classrooms.

4-7 Seminar Classrooms.

A. Use/Activities.
Seminar classrooms are used for small group discussions, briefings, or debriefings. They can also be used for counseling and remedial instruction.

B. Occupants.
Typically, fewer than 20 people will use this type of space; larger groups cannot have effective seminar-type discussions.

C. Equipment/Supplies.
This space will usually require one or more tables with chairs. Audio-visual equipment and wall-mounted graphics and media may sometimes be used.

D. Space Use.

(1) Size.
The minimum space required is about 20 square feet per person. Rooms should be planned for seminars of up to 12 persons. A seminar of this size will generate an average participation level of 92 percent; a 25-person seminar will average 75 percent.

(2) Shape.
The room shape should be slightly rectangular to provide the greatest flexibility of layouts. For a 12-person room, 15 feet by 16 feet is best. (Figure 4-33).

E. Access/Circulation.
Seminar rooms should be near instructor preparation rooms. They are also appropriately located near shop and laboratory classrooms; they can then be used to discuss assignments and objectives when there is other activity in these areas. (Figure 4-34).

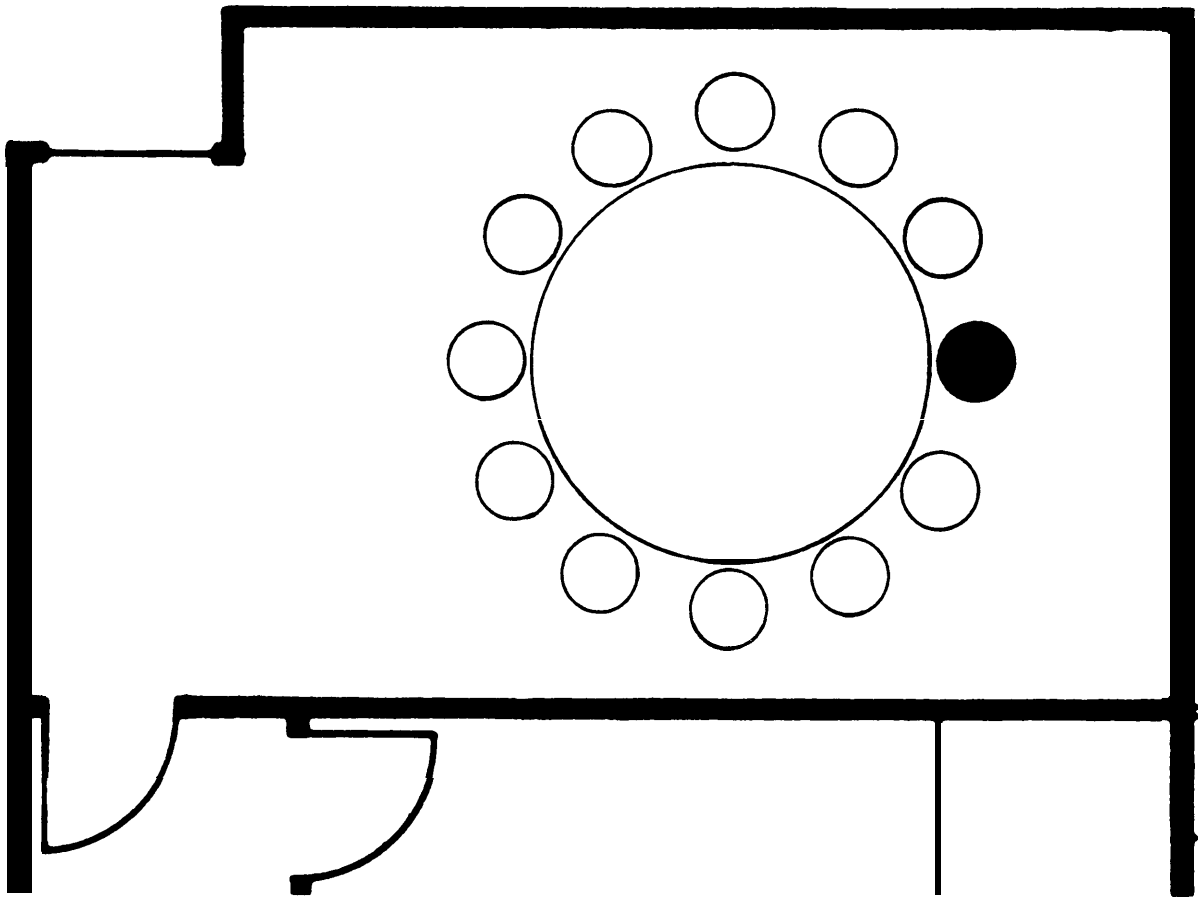


Figure 4-33
Seminar Classroom.

F. Environmental Conditions.

(1) Windows
Although views to the outside and natural lighting are not required, they are desirable. There is a greater feeling of spaciousness in a small room when there is a view to the outside. If windows operate and have screens, they will provide natural ventilation. Natural lighting will also provide the more relaxed and informal setting appropriate for a seminar classroom. Blinds or other light-omitting devices should be used as needed to block out daylight.

(2) Lighting.
Lighting levels should be adequate for reading and help create a relaxed and informal setting. The required lighting level is 50 foot-candles. Studies have shown that incandescent lighting, which has a psychologically warm color spectrum, creates relaxed and informal settings when used alone or with fluorescent lighting and accent lighting on walls.

G. Furniture.

(1) Effect on Group Dynamics.
In a seminar setting, where participants are to have an equal status or are to be drawn into the discussion, type and arrangement of furniture can affect group dynamics. Good eye contact among group members will promote interaction. Rectangular tables create dominant table positions at their ends. However, square tables and table arrangements reduce dominant positions, encourage subgroup formation, and improve eye contact in the group. Round tables result in best eye contact and make all seating positions equal.

(2) Shape and Arrangement.

a. It should be possible to arrange furniture in different ways to accommodate different numbers of students. Rectangular tables provide much flexibility in seating arrangements; round and square tables do not.

b. Furniture arrangement and size should promote interaction. Table size should allow the group to talk casually, without raising their voices, see details of each other's facial expressions, and pass written materials back and forth across the table. (Figure 4-35).

Table 4-5 Criteria for Computer-Aided Instructional Classrooms.

Space Criteria	
Area/Student	
Computer carrels	32 s.f.
Ceiling Height	9 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task-carrel lighting level	50 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	30-50%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Electrical	
Power	110 V; 330 volt-amperes per carrel (minimum)
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

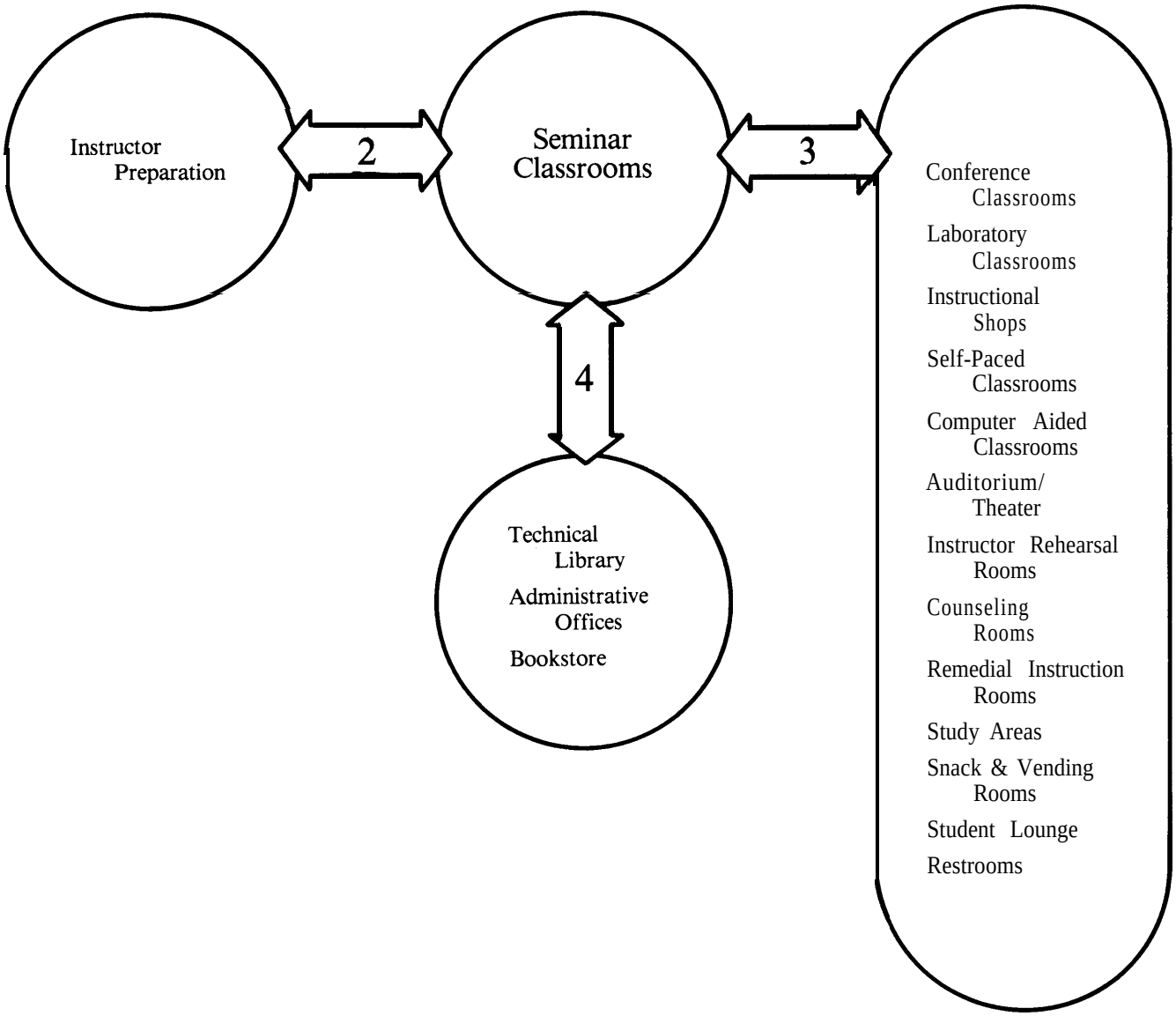
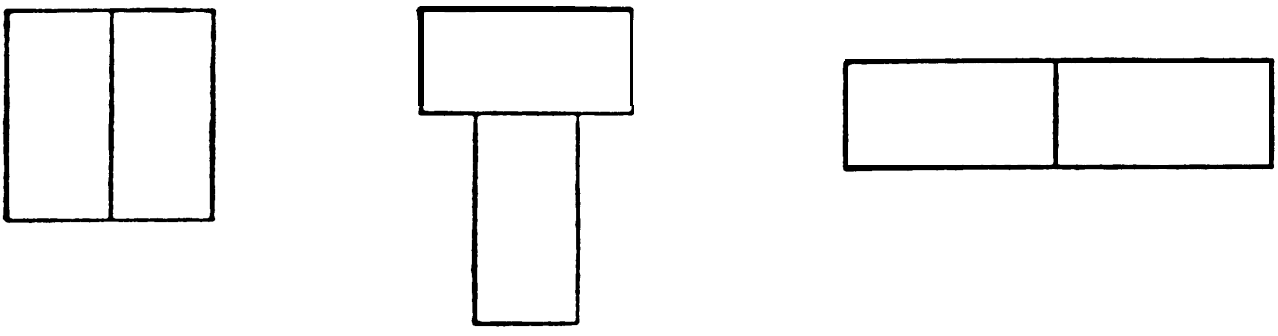
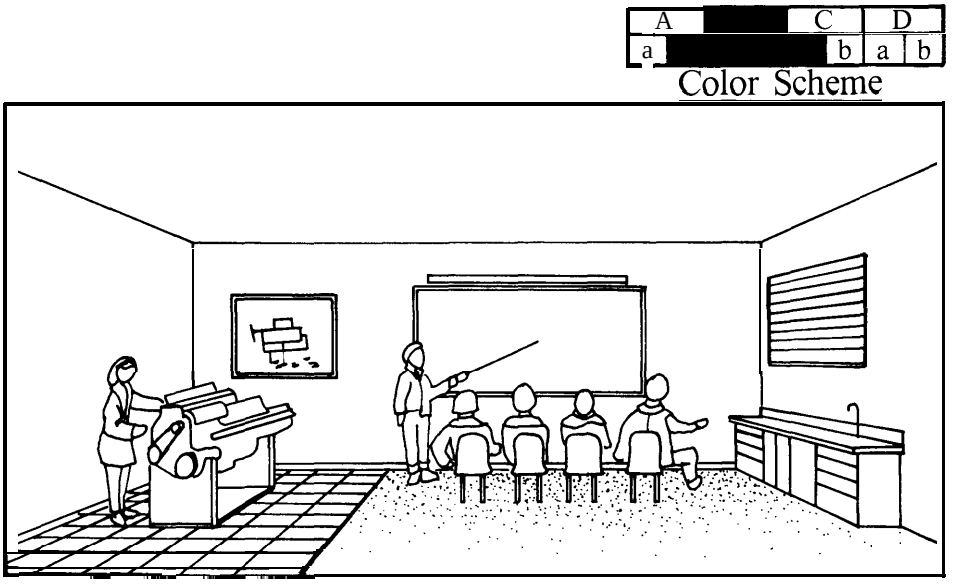


Figure 4-34
Spaces Near Seminar Classrooms.



Side by Side Side to End End to End

Figure 4-35
Table Arrangements.



Interior Design Recommendations

Background colors should be muted.
Brighter colors should be used for seating, tables, and trim.
Caution or hazard areas should be clearly marked.

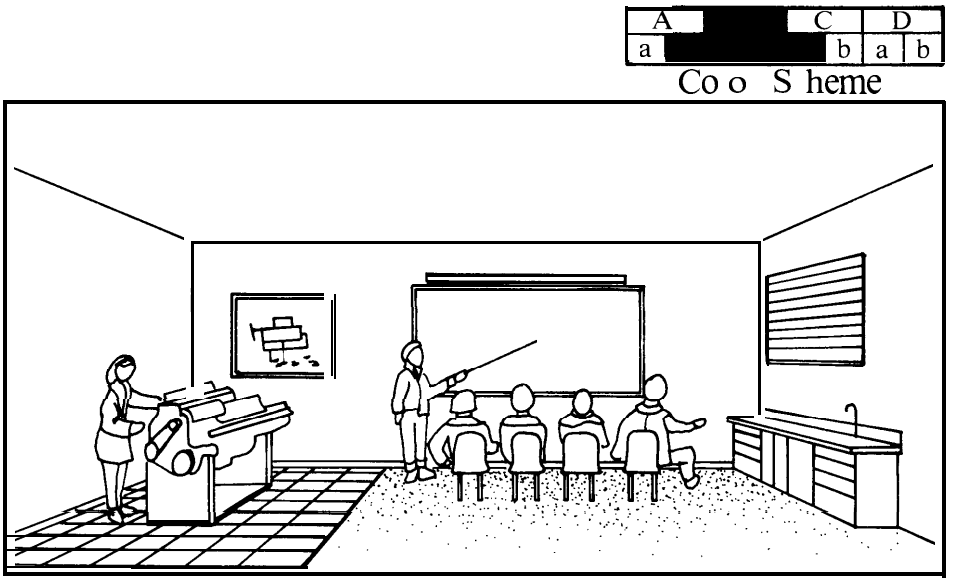
Room Finishes

Item	Recommended Characteristics
Walls	Painted concrete block or materials of similar durability should be used in lab area. All wall surfaces should be washable.
Floor	Hard, durable surfaces are recommended for easy maintenance and wearability. Seating area may be vinyl flooring.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Chairs should be vinyl covered or plastic for easy cleaning. Stackable or foldable seating will also allow flexibility.
Lighting	Task lighting should be adjustable to provide flexibility.
Lockers	Metal locker units or built-in cabinets should be used for storage of equipment and tools.
Curtains	Blackout shades are recommended. Colors should coordinate with overall color scheme.

Figure 4-36
Interior Design Recommendations for Seminar Classrooms.



Interior Design Recommendations	
Background colors should be muted. Brighter colors should be used for seating, tables, and trim. Caution or hazard areas should be clearly marked.	
Room Finishes	
Item	**Recommended Characteristics**
Walls	Painted concrete block or materials of similar durability should be used in lab area. All wall surfaces should be washable.
Floor	Hard, durable surfaces are recommended for easy maintenance and wearability. Seating area may be vinyl flooring.
Furniture & Accessories	
Item	**Recommended Characteristics**
Seating	Chairs should be vinyl covered or plastic for easy cleaning. Stackable or foldable seating will also allow flexibility.
Lighting	Task lighting should be adjustable to provide flexibility.
Lockers	Metal locker units or built-in cabinets should be used for storage of equipment and tools.
Curtains	Blackout shades are recommended. Colors should coordinate with overall color scheme.

Figure 4-36
Interior Design Recommendations for Seminar Classrooms.

H. Interior Design.

(1) For recommendations, see Figure 4-36. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.

Table 4-6 lists outline criteria for designing seminar classrooms.

Table 4-6 Criteria for Seminar Classrooms.

Space Criteria	
Area/Student	20 s.f.
Ceiling Height	8 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	30-70%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task-carrel lighting level	50 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Optional
Acoustic	
Enclosing sound wall rating:	
Between seminar and corridor	STC 40
Between seminar and instructional spaces	STC 45
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
walls	Reflective
Floor	Absorptive, NRC 25 (minimum)
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

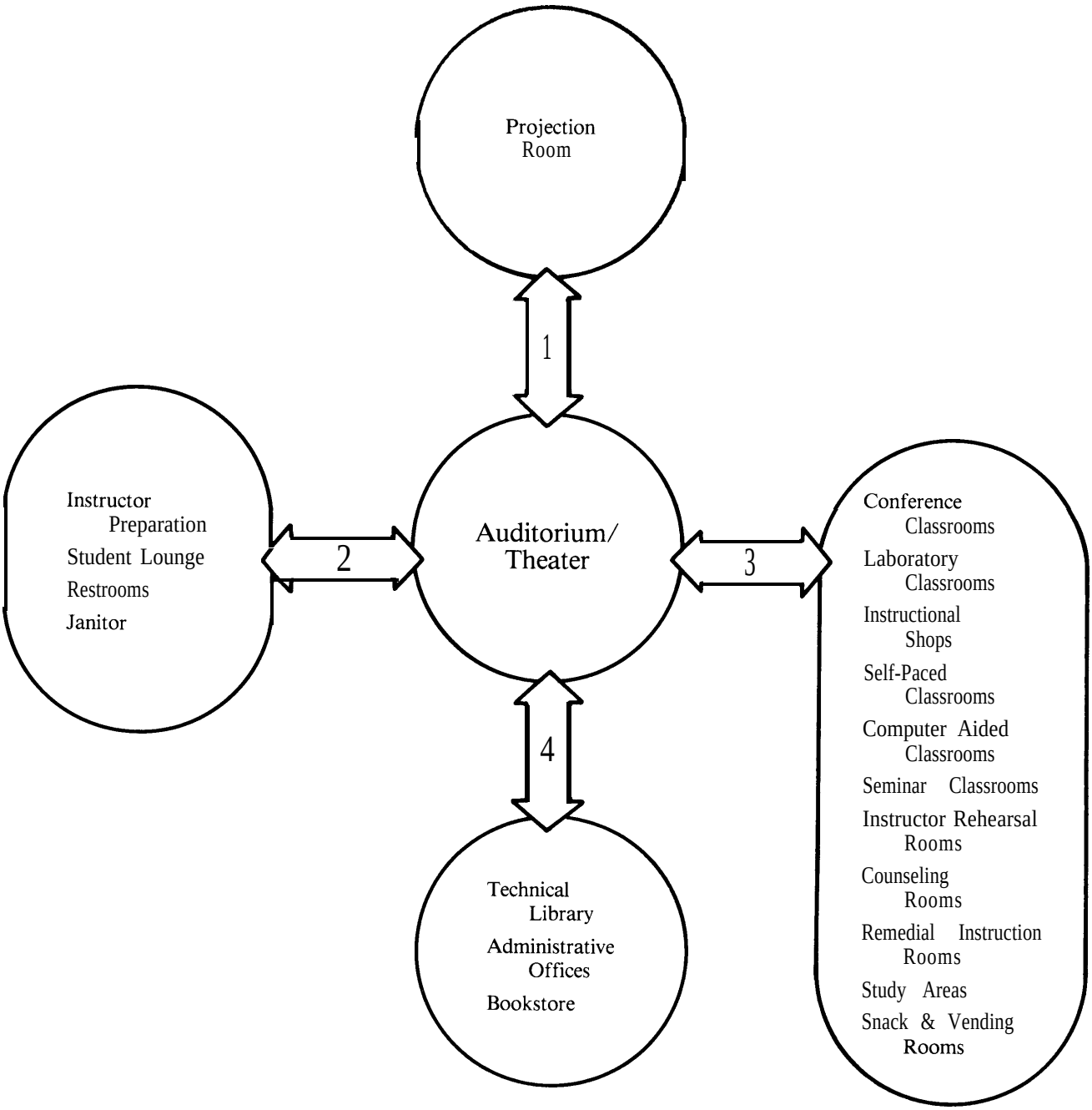


Figure 4-37
Spaces Near Auditoriums and Theaters.

4-8 Auditorium/Theater.

A. Use/Activities.
An auditorium or theater is used to make a presentation to large audiences. Presentations may include the use of A-V media.

B. Occupants.
This type of space usually must accommodate one or more speakers plus an audience (100 people or more), and possibly some technicians or aides (up to three people).

C. Equipment/Supplies.
Equipment usually includes a lectern or table, a screen for A-V materials, microphones, speakers at the front of the room, and special lighting for the speaker platform or stage. The audience may require seats with attached writing surfaces. A special room for projection equipment and audio and lighting controls is usually provided.

D. Access/Circulation.

(1) Location.
See Figure 4-37.

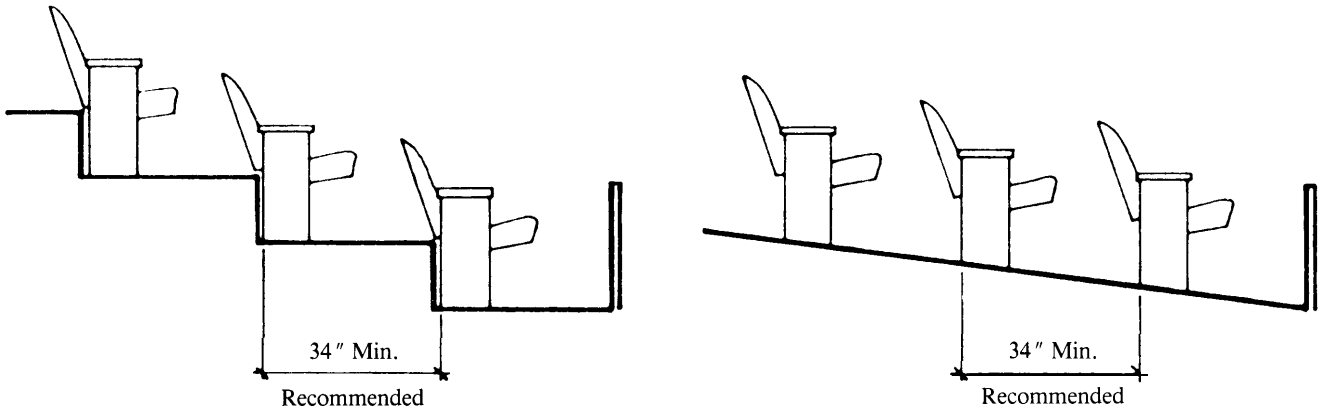
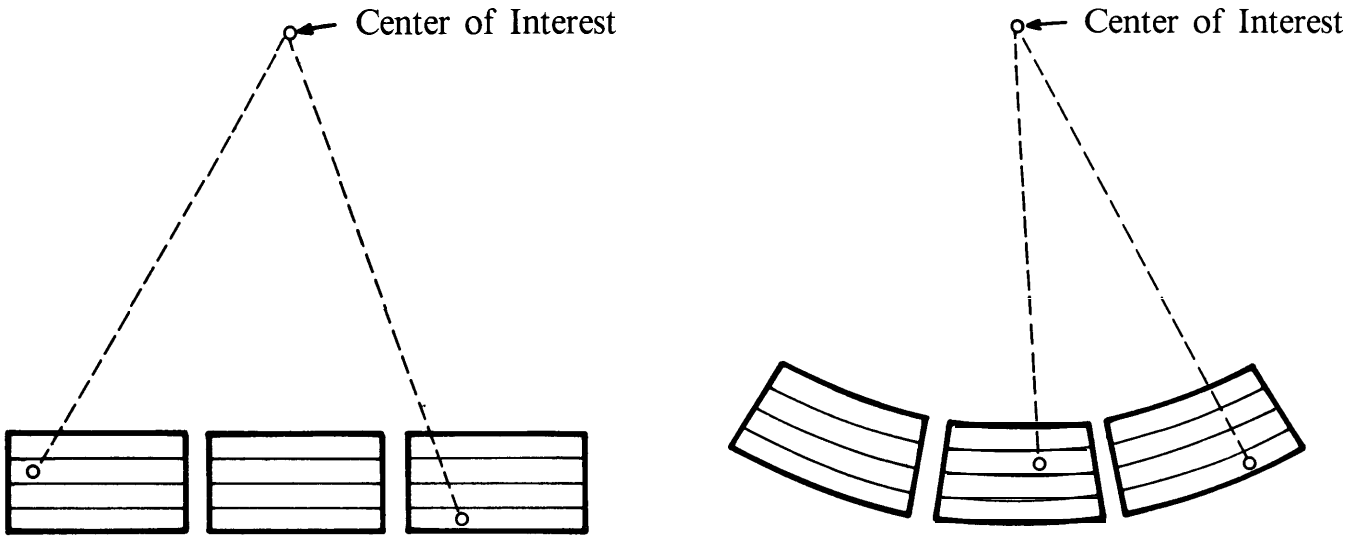


Figure 4-38
Tiered Seating



Straight Rows.

Uncomfortable for individuals seated at sides because the center of interest does not coincide with the natural lines of sight.

Curver Rows.

Most desirable because of comfort and east of vision.

Figure 4-39
Types of Rows.

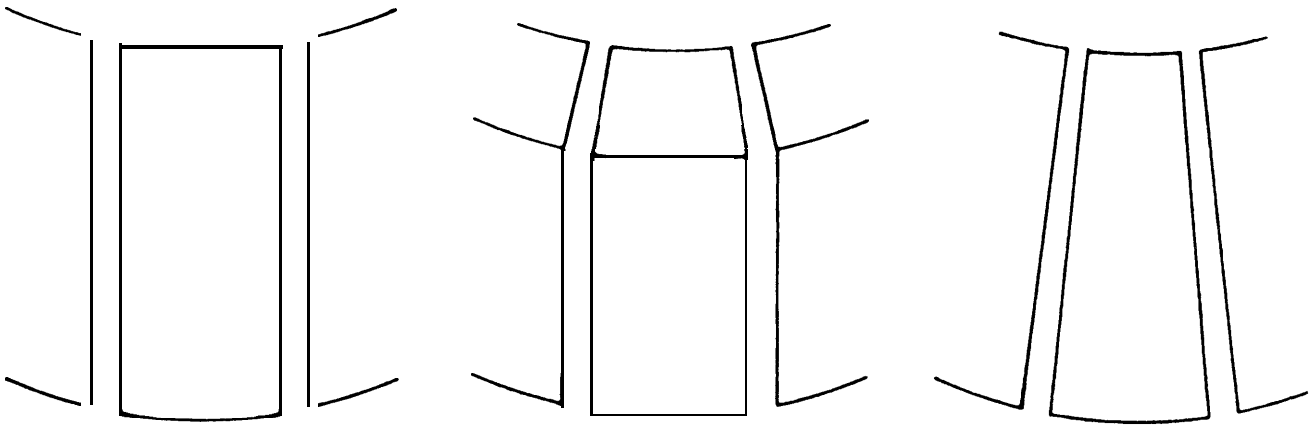


Figure 4-40
Typical Three-Bank Layouts.

(2) Circulation Within Room.

a. Instructor platforms that are easy to reach and large enough for the instructor's needs must be available.

b. All seats should have a good view of the speaker and/or screen. Floors may be sloped or tiered. (Figure 4-38). Rows may run straight across the entire theater. Side banks may be canted or entire rows may be curved. Seat construction makes the minimum radius for curved rows 20 feet. The center for radii of rows and center of screens or stage need not coincide, although this is the ideal. When rows are curved, a sloping auditorium floor should be a compound curve or amphitheater type to prevent tilted side seats. Aisles may be straight, curved, parallel, or radial. (Figure 4-39). For best traffic flow, aisles should run at right angles to rows. (Figure 4-40).

c. Requirements for cross aisles vary with the number of seats served and aisle width. Typical rules are that no seat should be more than seven seats away from an aisle and that a minimum aisle width be 3 feet, increasing by varying factors in relation to aisle length. Requirements for cross aisles vary with the number of seats served and aisle width. Rows should not be less than 34 inches apart (seat back to seat back). Seats within each row should not be less than 20 inches on center. Continental seating (in which spaces between rows widen and become aisles) will considerably reduce an auditorium's seating capacity. Aisle widths, number of aisles, seat density, seats in a bank, aisle width, and number of exits and exit locations are specified in local codes and in Life Safety Code 101 of the National Fire Code.

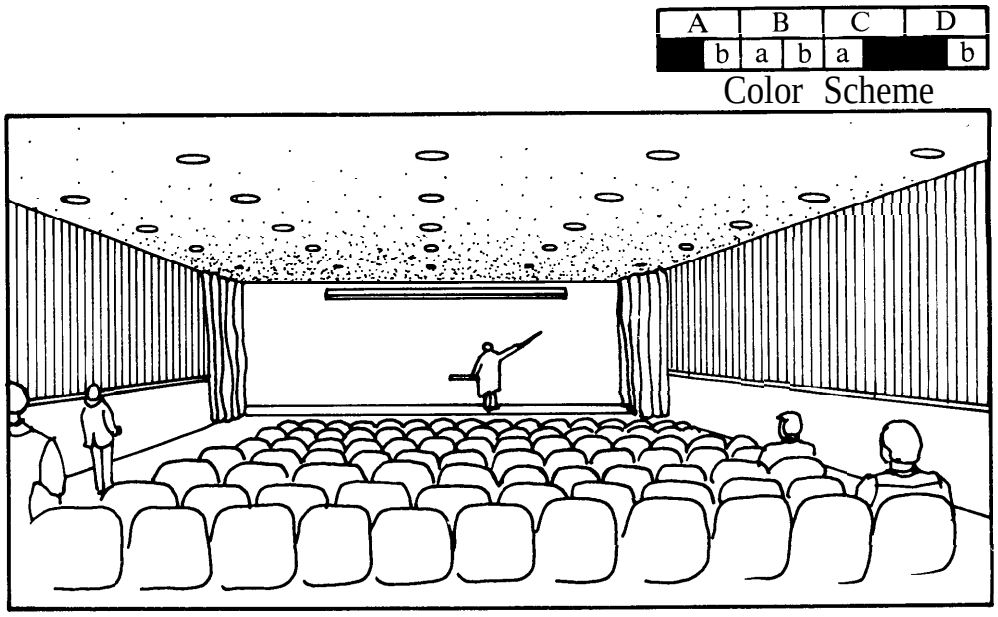
E. Environmental Conditions.
Consideration should be given to the acoustical treatment of auditoriums. In large spaces like auditoriums, a technical expert in sound and acoustics should be consulted to make sure that desired effects are achieved.

F. Furniture.

(1) Selection of seats should be based on comfort, cost, size, use, and durability. Each seat should be equipped with a foldaway arm for note-taking. Upholstery variations include spring-edge seats (most luxurious, most expensive); box spring seats (nearly as comfortable as spring-edge seats); spring-back seats; and padded-back seats. Veneer-back seatings are more durable than other types. Upholstered seats give the best acoustical control. Seats are sized based on width; front-to-back depths vary only slightly.

(2) Seat backs which slope backward will require increased spacing between rows.

G. Communication.
Visual aids should be selected based on the need for good visibility by each student. Large classrooms (i.e., those seating several hundred students) should use overhead transparency projectors instead of chalkboards. The installation and use of overhead projectors demand little room preparation. However, the room's ceiling must be high enough to mount a screen large enough for all students to see. Screens are usually mounted about 3 feet from the front wall of the room; the screen bottom is drawn back to the wall to eliminate image keystoning (i.e., to keep the picture square and in focus).



Interior Design Recommendations

Colors should be muted.
Furniture and finishes should be durable for heavy use.

Room Finishes

Item	Recommended Characteristics
Walls	Vinyl wallpaper is recommended because of its durability and easy maintenance properties.
Floor	Carpet is recommended for aisles only. This application is acoustically sensitive but does not create major maintenance problems.
Trim	Use durable vinyl, hardwood, or metal.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Reference Criteria for Auditorium/Theater Furniture.
Platform	Specific characteristics should be based on local requirements.
Lecturn	Reference Criteria for Classroom Spaces/Conference Classrooms Communication.

Figure 4-41
Interior Design Recommendations for Auditoriums and Theaters.

H. Interior Design.

(1) For recommendations, see Figure 4-41. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.

Table 4-7 lists outline criteria for designing auditoriums and theaters.

Table 4-7 Criteria for Auditoriums and Theaters.

Space Criteria	
Area/Student	7½ s.f./student 35 s.f.
Ceiling Height	10 ft. minimum
Floor Loading	Reference: TM 5-809-1, Structural Design
Special Characteristics	Student sight lines are critical; depending on the size of the audience and nature of the presentation, platforms for instructors and risers for seating may be required.
Seating Spacing	Reference: NFPA-101
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	30-70%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained) dimming controls for use by instructor
A-V lighting level	30 fc., reference: paragraph 3-4f
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	No
Acoustic	
Enclosing sound wall rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Reflective
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-9 Instructor Preparation Areas.

A. Use/Activities.
Instructors use these spaces to prepare personal instruction materials and to store current reference materials; they also have sound-controlled typing stations. If the area has good audio or visual privacy, it can also be used for student counseling. Each instructor in this space has an individual work station.

B. Occupants.
Each instructor area will contain one or two instructors, depending on the type of partitioning system.

C. Equipment/Supplies.
Each instructor's work station has a desk and chair, a visitor's chair, and a carrel-type shelf over the desk or a separate storage shelf unit. Typing stations have a typewriter stand or a typing desk and storage space for reference or supply materials.

D. Space Utilization.

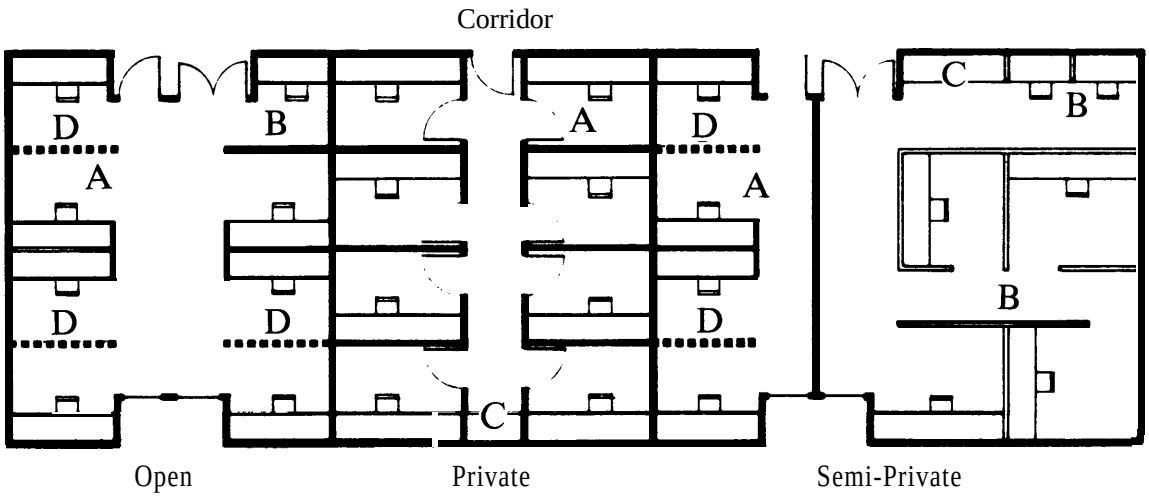
(1) Size.

a. There should be enough space for instructors to prepare their lectures. Each instructor will have 90 square feet.

b. Seventy square feet should be provided for each preparation area, 30 square feet for each typing booth, and 11 square feet for each section of shelving or each storage cabinet.

(2) Shape.
Office space should be based on semi-private (three walls) office planning configurations. (Figure 4-42).

E. Access/Circulation.
Instructor preparation areas should be clustered near classrooms to facilitate joint use of storage and typing facilities and informal intra-staff consultation. (Figure 4-43).



A Instructor Preparation
B Typing Station
C Storage
D Privacy Curtain

Figure 4-42
Instructor Preparation Areas.

F. Furniture.
Instructors need visual and some sound privacy. Typing stations need good sound isolation. The general instructor preparation area should be open, with shoulder-height partitions between each instructor's area. Typing booths should be enclosed with full-height partitions.

G. Interior Design.

(1) For recommendations, see Figure 4-44. For example color schemes called out in the figure, see the Appendix.

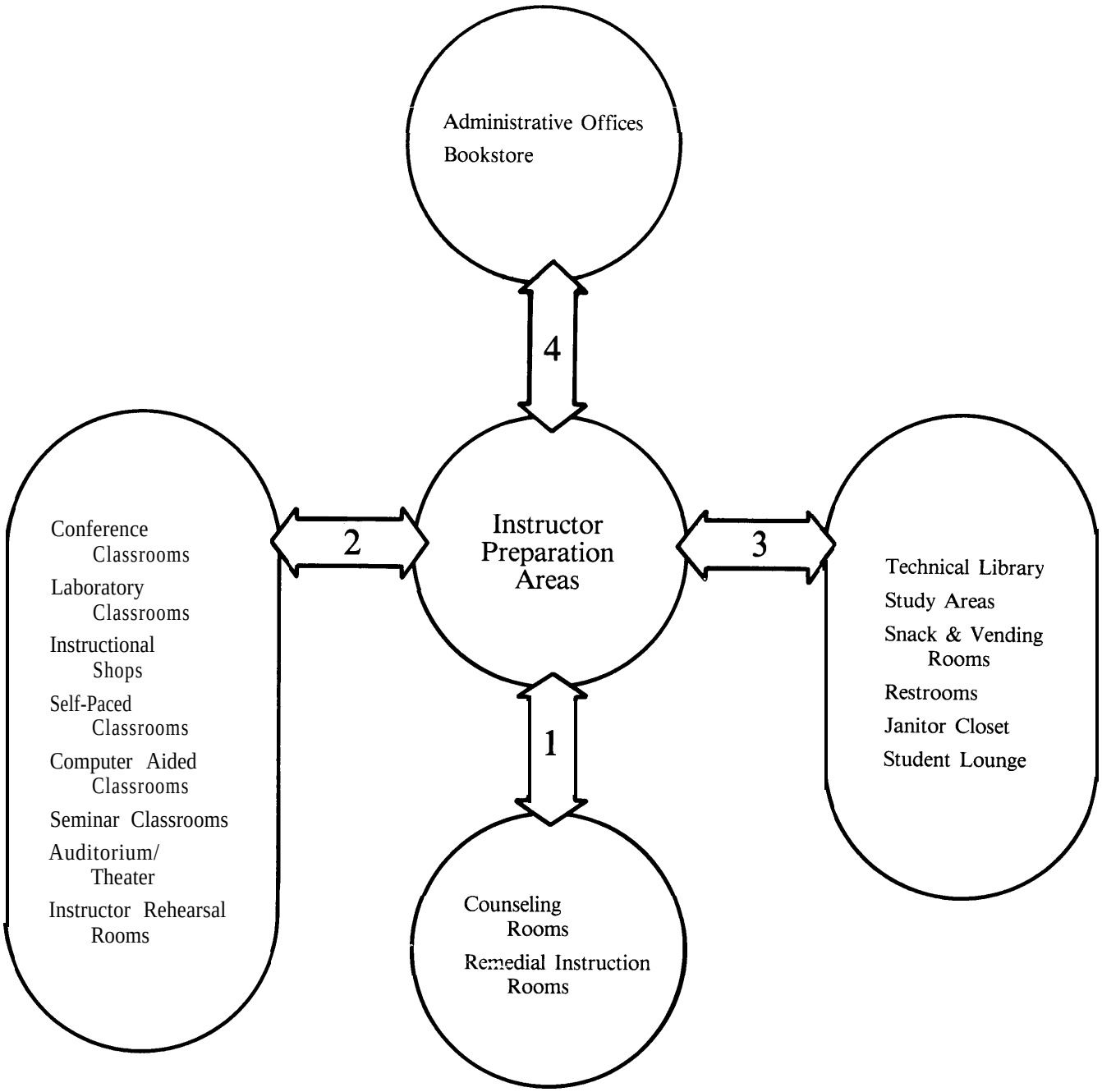
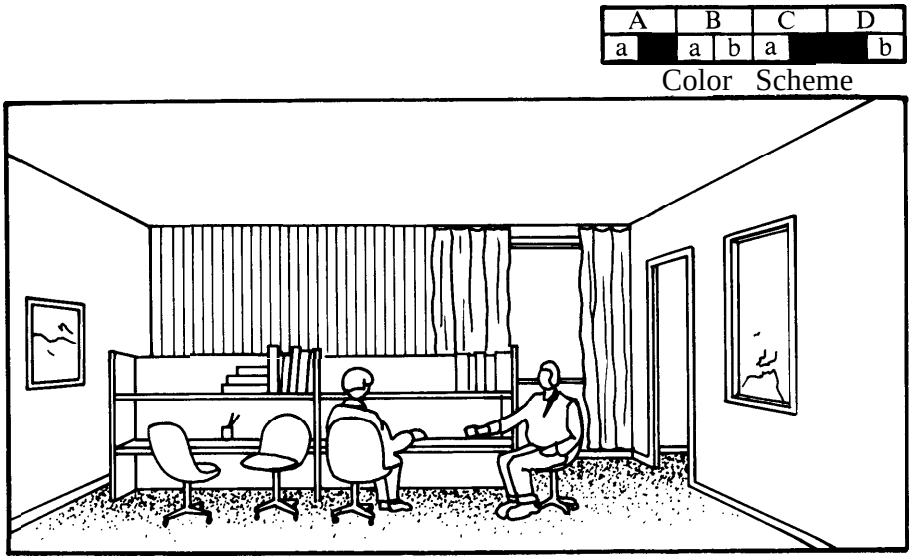


Figure 4-43
Spaces Near Instructor Preparation Areas.



Interior Design Recommendations

The design of Instructor Preparation rooms should allow for instructors to individualize their own areas with personal objects. A neutral color scheme allows each instructor flexibility for personalization.

Room Finishes

Item	Recommended Characteristics
Walls	Use light colors to allow for flexibility. Flat paint is recommended to reduce glare.
Floor	Use recommended carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.

Furniture & Accessories

Item	Recommended Characteristics
Seating	At least one upholstered, swivel chair with casters is recommended per instructor area. One compatible chair is also required for instructor student counseling.
Desk	Desks, partitions, and shelves should all be part of an integrated open office system.
Curtains	Open weave curtains are recommended to limit direct sunlight, Colors should coordinate with the overall color scheme.

Figure 4-44
Interior Design Recommendations for Instructor Preparation Areas.

(2) For general guidance on interior design, see DG 1110-3-122.

H. Criteria.
Table 4-8 lists outline criteria for designing instructor preparation areas.

Table 4-8 Criteria for Instructor Preparation Areas.

Space Criteria	
Area/Student	90 s.f.
Ceiling Height	10 ft.
Floor Loading (minimum)	50 psf, 70 psf with partitions
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task lighting level	70 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between preparation spaces and corridors	STC 40
Between preparation spaces and classrooms	STC 45
Sound reflectance: Ceiling	Absorptive, NRC 50 (min.)
Floor	Absorptive, NRC 25 (min.)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-10 Instructor Rehearsal Rooms.

A. Use/Activities.
Instructors use this space to practice a lecture or demonstrations. A small audience may help with or criticize the presentation; lectures are sometimes videotaped. Instructor rehearsal rooms are sometimes also used for student counseling or remedial instruction.

B. Occupants.
This space must accommodate an instructor, a small audience, and equipment operators.

C. Equipment/Supplies.
Typical equipment used in this space may include a lectern or instructor table with A-V controllers; instructor platform; desks or chairs and tables for the audience; A-V equipment (projection screen and microphones, slide, movie, or viewgraph projector; audio and television recording equipment); special lighting and lighting controls; and chalkboards and backboards.

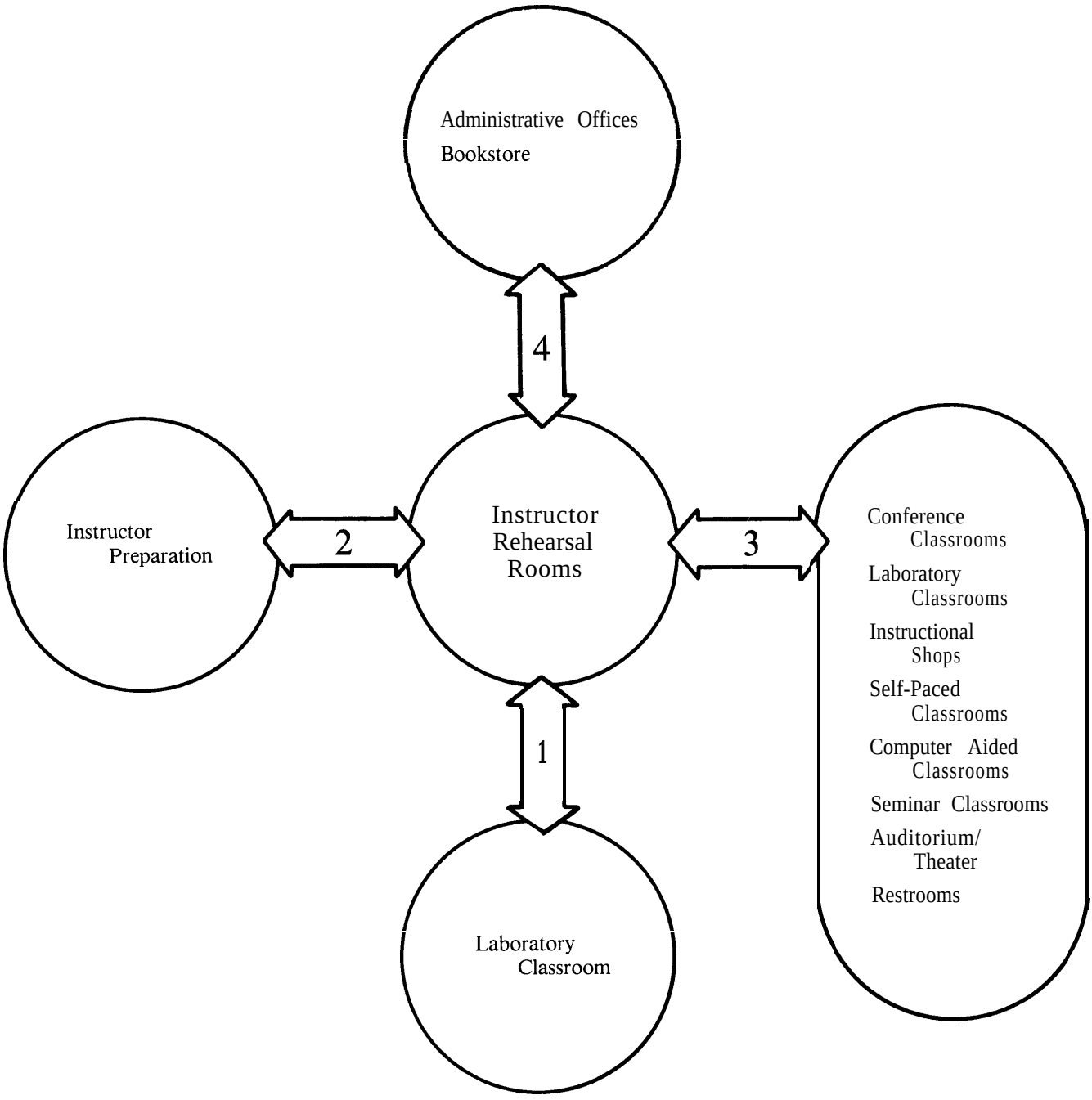


Figure 4-45
Spaces Near Instructor Rehearsal Rooms.

D. Space Utilization.

(1) Size.
The room should be about the same size as a seminar room (paragraph 4-5e above).

(2) Shape.
The room should be about the same shape as a seminar room (paragraph 4-5e above).

E. Access/Circulation.
The room should be located to allow convenient use of the room for seminar classes as required. Primary consideration, however, should be given to a location next to the instructor preparation areas; this will facilitate use and control of the area, as well as provide private counseling space. (Figure 4-45).

F. Environmental Conditions.
Adequate lighting should be provided for A-V materials and practice lectures/demonstrations (paragraph 4-8a above). A separate control should be provided for the platform lighting. The general lighting level will be 50 foot-candles. The A-V lighting level is 30 foot-candles for viewing; 70 foot-candles for black and white videotaping and 250 foot-candels for color videotaping.

G. Furniture.
The rehearsal room should be adequately furnished. All furniture surfaces must be durable and easy to maintain. The rehearsal room should have A-V controls, a projection screen, a blackboard, and 10 to 12 desks. (Figure 4-46). There should be a television cassette unit so taped presentations can be reviewed and to allow monitoring of lectures during taping (paragraph a above).

H. Interior Design.

(1) For recommendations, see Figure 4-47. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.
Table 4-9 lists outline criteria for designing instructor rehearsal rooms.

A Projection Station
B TV Monitor & Recorde
C Projection Screen
D Lectern
E Student Station
F Platform

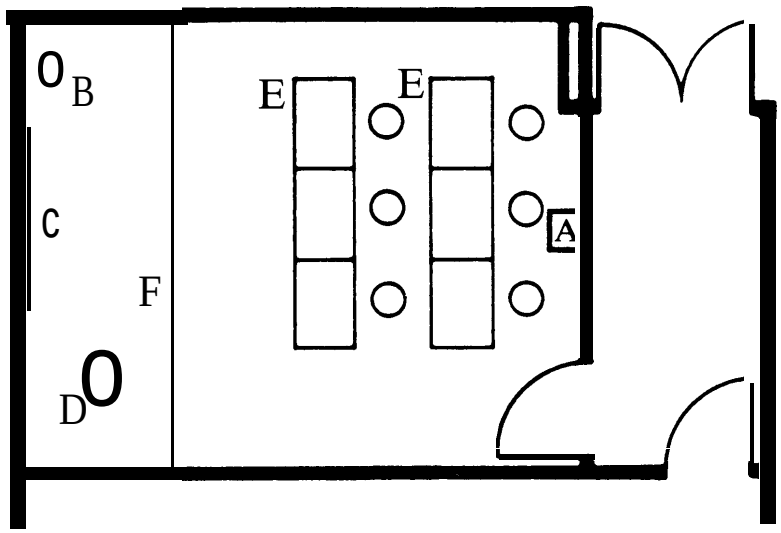
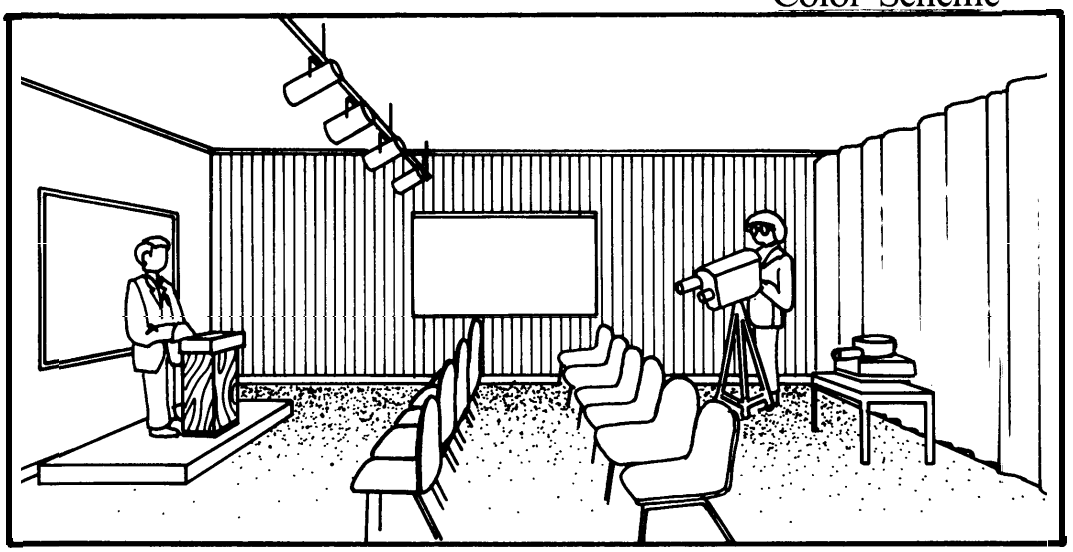


Figure 4-46
Instructor Rehearsal Room.

A	B	C
b a	b a	

Color Scheme



Interior Design Recommendations

Room Finishes

Item	Recommended Characteristics
Walls	Use flat paint in recommended colors to reduce glare. Coordinate with the overall interior design scheme.
Floor	Use recommended carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Chairs with tablet arms are recommended.
Platform	A small, moveable wood platform is suggested for flexibility.
Curtains	Blackout shades are recommended. Colors should coordinate with the overall color scheme.

Figure 4-47
Interior Design Recommendations for Instructor Rehearsal Rooms.

Table 4-9 Criteria for Instructor Rehearsal Rooms.

Space Criteria	
Area/Student	250-375 s.f.
Ceiling Height	9 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
A-V lighting level: Viewing	30 fc. (maintained)
Taping (black & white)	70 fc. (maintained)
Taping (color)	250 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Not required
Acoustic	
Enclosing sound wall rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Reflective
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110/220 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-11 Counseling Spaces.

A. Use/Activities.
Counseling spaces are areas where instructors meet with individual students to discuss academic problems. Instructor preparation areas, instructor rehearsal rooms, empty classrooms, seminar rooms, or other areas which have audio and visual privacy are used for counseling.

B. Occupants.
Counseling spaces usually must accommodate one instructor and one student.

C. Equipment/Supplies.
This type of space usually requires two chairs of the same height (so an instructor does not intimidate the student by looking down at him or her) and a low, small table.

D. Space Utilization.
There should be enough space for two or three people to sit and talk with a comfortable distance between them. Each counseling room should be about 80 square feet. Ideal dimensions would be 8 by 10 feet or 9 by 9 feet. The ceiling should not be more than 9 feet high.

E. Access/Circulation.
Counseling rooms should be private. Counseling rooms should be near other instructor spaces so that instructors and supervisors can control their use. When possible, counseling rooms should be separate, with walls and a closable door, not partitioned spaces. (Figure 4-48).

F. Environmental Conditions.

(1) Windows.
Counseling spaces should not give a feeling of claustrophobia. Although the counseling space should be private, it may have windows in one wall to create a more spacious feeling. Windows on an interior wall should open onto a little-used circulation path, not onto an area where people are sitting. Furniture should be arranged so that neither the instructor's nor the student's back faces the windows.

(2) Sound.
Counseling spaces should be private. Walls and doors of the counseling space should be soundproofed well enough so confidential discussions are not overheard. If the counseling room is along a circulation path, the room should be acoustically treated so outside noises do not disturb or distract the instructor and student.

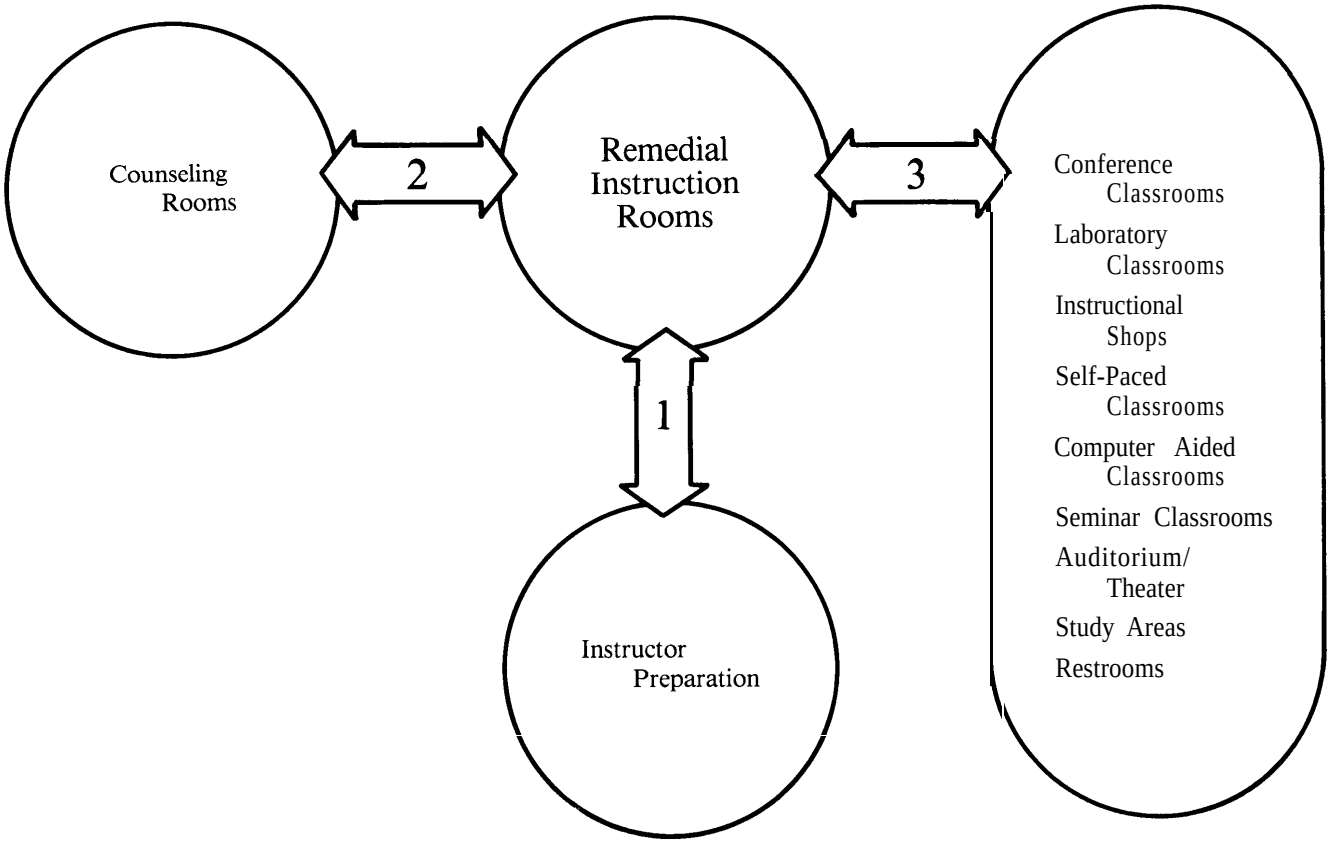
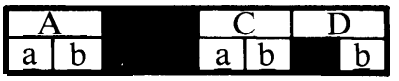
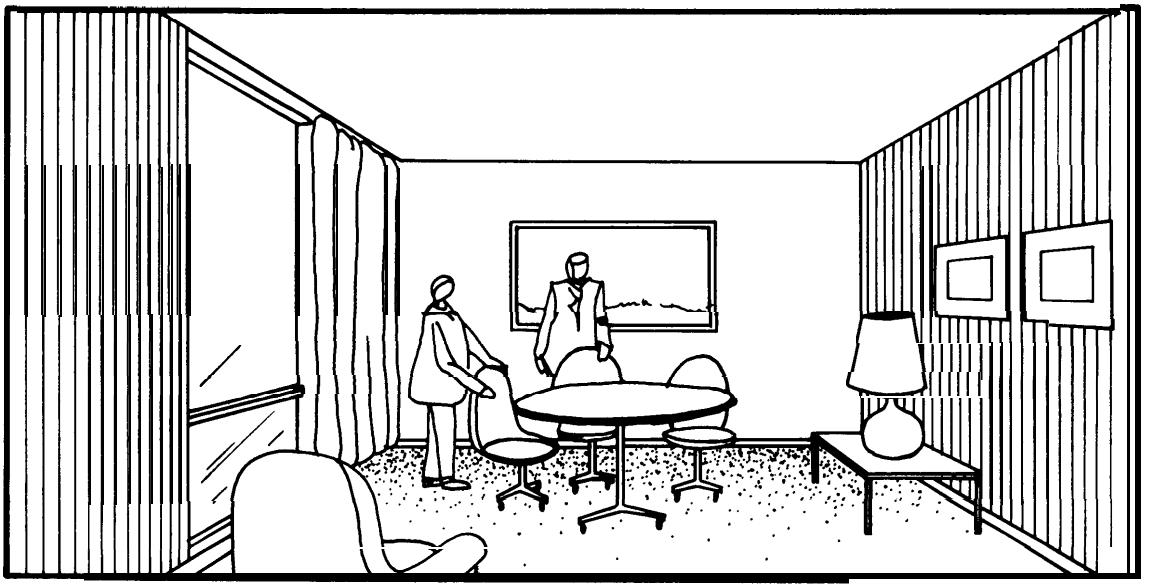


Figure 4-48
Spaces Near Counseling Spaces.



Color Scheme



Interior Design Recommendations

Room Finishes

Item	Recommended Characteristics
Floor	Use recommended carpeting to help create a comfortable quiet space

Furniture & Accessories

Item	Recommended Characteristics
Seating	Chairs should be comfortable but without swivel mechanism.
Table	A small round conference table in recommended wood finish is appropriate.
Curtains	Open weave curtains are recommended to limit direct sunlight.

Figure 4-49
Interior Design Recommendations for Counseling Spaces.

G. Interior Design.

(1) The general character of counseling spaces should be informal.

(2) **Recommendations.**

a. For recommendations, see Figure 4-49. For example color schemes called out in the figure, see the Appendix.

b. For general guidance on interior design, see DG 1110-3-122.

H. Criteria.

Table 4-10 lists outline criteria for designing counseling spaces.

Table 4-10 Criteria for Counseling Spaces.

Space Criteria	
Area	80 s.f.
Ceiling Height	9 ft.
Floor Loading	50 psf, 70 psf with partitions (minimum)
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35070 (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task lighting level	70 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between preparation spaces and corridors	STC 40
Between preparation spaces and classrooms	STC 45
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 v
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-12 Remedial Instruction Spaces.

A. Use/Activities.
Based on a student's performance in class or on information obtained during academic counseling, an instructor may decide that a student needs remedial help. This usually involves supervised study or a review of troublesome material in a one-on-one setting. Remedial instruction may take place in the instructor preparation area (if there is a place for a student to sit undisturbed in the instructor's view) or in empty classrooms, instructor rehearsal rooms, or seminar classrooms.

B. Occupants.
Remedial work spaces usually accommodate one instructor and one student. Supervised study areas usually accommodate one instructor and as many as three or four students.

C. Equipment/Supplies.
Remedial instruction spaces usually have a desk or table and chair for each student, and an instructor's work station. Work stations should be placed so the instructor can do his/her own work while supervising the student.

D. Space Utilization.
Remedial instruction spaces should be large enough to accommodate one instructor and a maximum of three or four students. Each remedial instruction area should be 100 square feet.

E. Access/Circulation.
See Figure 4-50.

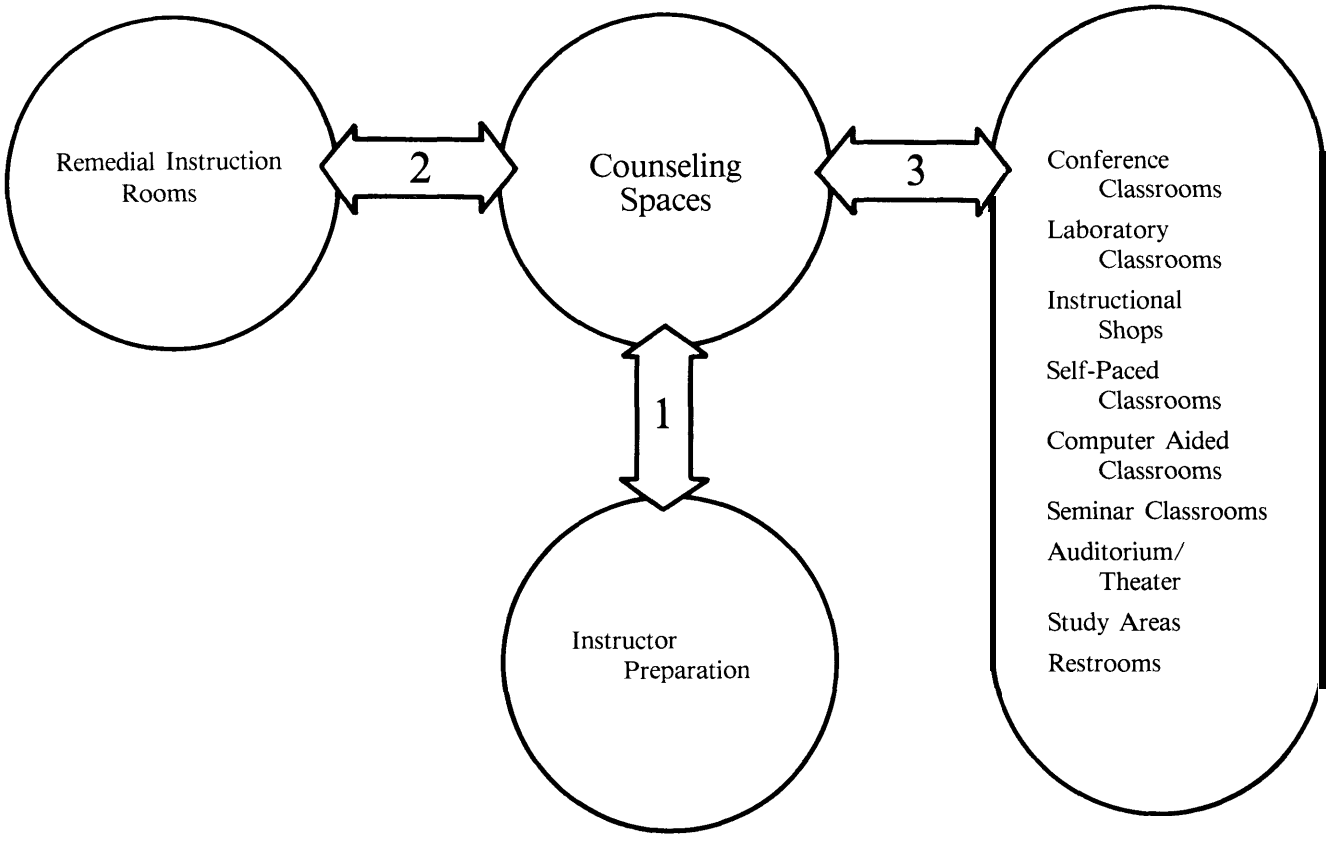


Figure 4-50
Spaces Near Remedial Instruction Spaces.

F. Environmental Conditions.
Occupants should not feel closed in. Windows help create a more spacious feeling, especially in small rooms.

G. Criteria.
Table 4-11 lists outline criteria for designing remedial instruction spaces.

Table 4-11 Criteria for Remedial Instruction Spaces.

Space Criteria	
Area/Room	100 s.f.
Ceiling Height	9 ft.
Floor Loading	50 psf, 70 psf with partitions (minimum)
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task lighting level	50 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between preparation spaces and corridors	STC 40
Between preparation spaces and classrooms	STC 45
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-13 Technical Library.

A. Use/Activities.

(1) A typical service school technical library provides topical references oriented to the school's field of instruction. The library's function is similar to that of a departmental library in a large university. It provides reference materials for administrative personnel and instructors and, to a lesser extent, students.

(2) Library users borrow and return reference materials, browse through the stacks or film holdings, check catalog files, etc. The library staff acquires, catalogs, files, checks out and receives materials, and helps users locate references.

(3) The instructional program provides most student reference material. The technical library is independent of other post libraries and, as a rule, is not available to nonschool personnel.

B. Occupants.
This space usually accommodate one librarian, several library aides, and many users. The number of users in the library at one time depends on the school's size and the time of day.

C. Equipment/Supplies.
The library usually has stack and storage areas with shelving or microfiche files; drawer files for reference materials; work stations with equipment for users to view films or read reference materials or to write while working from references; catalog files and index displays; checkout and return areas; and staff areas with equipment for ordering, cataloging, and processing new materials. See Chapter 8 of DG 1110-3-110 for guidance on technical libraries.

D. Space Utilization.
There should be enough library space. Reading areas and the circulation desks, including traffic, require 25 square feet per person reading. Space required for classified storage vaults and reading rooms is determined on a case-by-case basis. The number of work stations or carrels used for microfiche, microfilm, or other A-V media is based on each library's needs. Typically, stack areas are sized so there is 1 square foot of floor area for every 15 books. This rule includes aisles between bookshelves and assumes stacks are six to seven shelves high. For more detailed instructions for programming library space, refer to DG 1110-3-110, Chapters 2 and 3.

E. Access/Circulation.

(1) Location.
Location of the technical library should provide ready access for organizational elements which use it most. These are administrative personnel (especially those associated with combat, doctrine, and training developments) and instructional staff. The library must also be located so as not to interfere with expansion plans for other school facilities and so that it can be expanded with minimal disruption of library operations. (Figure 4-51).

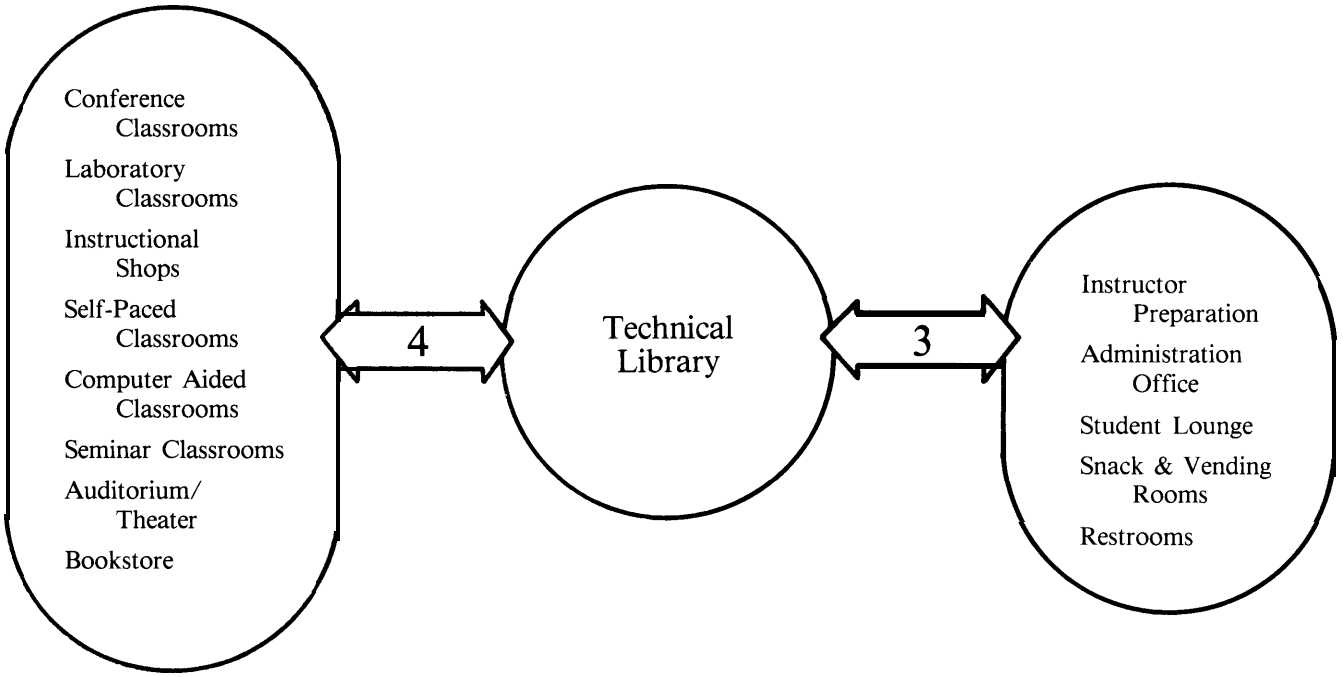


Figure 4-51
Spaces Near the Technical Library.

(2) Circulation Within Room.
Stack aisles should be large enough to allow materials to be viewed easily. The recommendation face-to-face spacing between book stacks is 3 feet.

F. Environmental Conditions.

(1) Lighting.

a. Different kinds of lighting should be used throughout the library to satisfy different visual task requirements. Specially designed lighting systems should be used in the stack, carrel, and reading areas and at the circulation desk. A lighting designer or engineer should recommend proper lighting systems during the design phase.

b. The general required lighting level is 50 foot-candles.

(2) Storage.
There should be enough storage to accommodate both existing and future learning resources. (Figure 4-52).

G. Furniture.
Library furniture should be attractive and comfortable. If the library is supervised, there is less chance that students will abuse the furniture. Therefore, couches and cushioned chairs can be used in specified reading areas.

H. Interior Design.

(1) For recommendations, see Figure 4-53. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.
Table 4-2 lists outline criteria for designing a technical library.

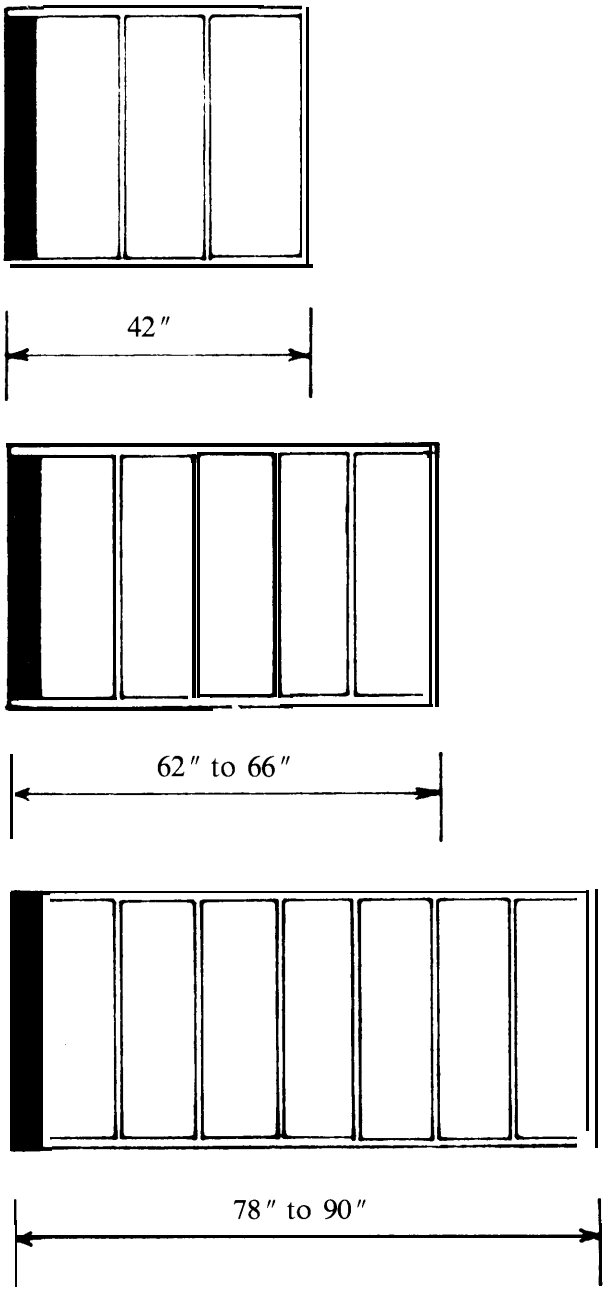
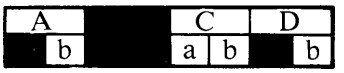
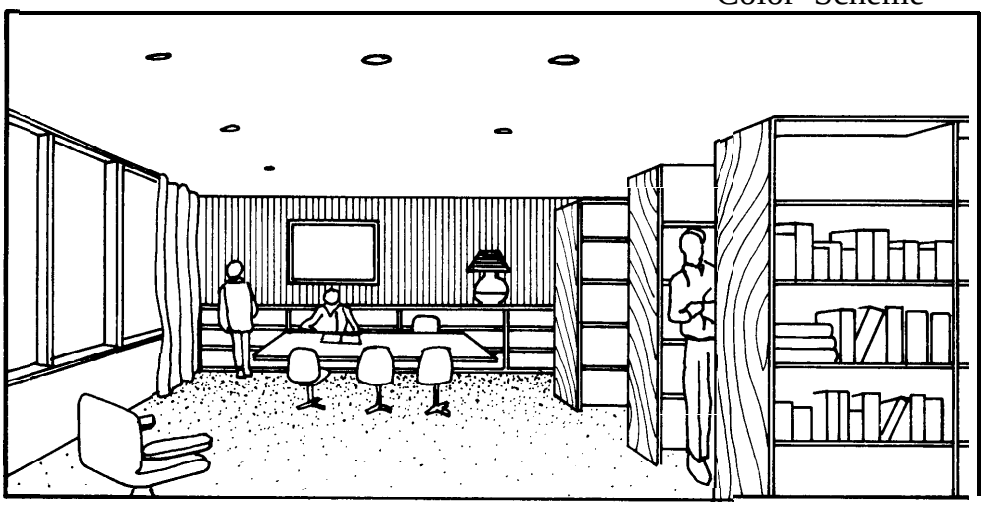


Figure 4-52
Typical Heights for 3-Foot-Wide Storage Units.



Color Scheme



Interior Design Recommendations

Muted colors help to minimize distractions.
There should be a variety of furniture types to allow different modes of study.

Room Finishes

Item	Recommended Characteristics
Walls	Use flat paint in recommended colors.
Floor	Use recommended carpeting.

Furniture & Accessories

Item	Recommended Characteristics
Seating	A mixture of comfortable table seating and lounge chairs is recommended.
Tables	Plastic laminate is recommended.
Carrels	Plastic laminate is recommended.
Bookcase	Finish should match doors and trim as appropriate.
Desk	The service desk should be compatible with overall design and finish.
Curtains	Open weave curtains are recommended to limit direct sunlight.

Figure 4-53
Interior Design Recommendations for a Technical Library.

Table 4-12 Criteria for a Technical Library.

Space Criteria	
Area	preference: paragraph 3-5
Ceiling Height	8 ft. for stacks
Floor Loading	125 psf
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating	STC 45
Sound reflectance: Ceiling	Absorptive
Floor	Absorptive
Service Criteria	
Electrical	
Power	110/120 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Special Criteria	
Security Vault (as required)	See DG 1110-3-110, Chapter 12

4-14 Study Areas.

A. Use/Activities.
Students use this type of space to do independent reading and writing.

B. Occupants.
The number of students a study area must accommodate depends on a school's curriculum and training methods.

C. **Equipment/Supplies.**
Study areas typically have a comfortable chair (for reading), desks or tables and chairs, and properly equipped carrels (for self-paced lessons). Specially designed study areas may be needed if students must practice using special equipment.

D. Space Utilization.
Size. Study areas should be large enough to meet most needs. Each study area should provide 30 square feet per student (including circulation). The number of students to be accommodated at one time will vary by school.

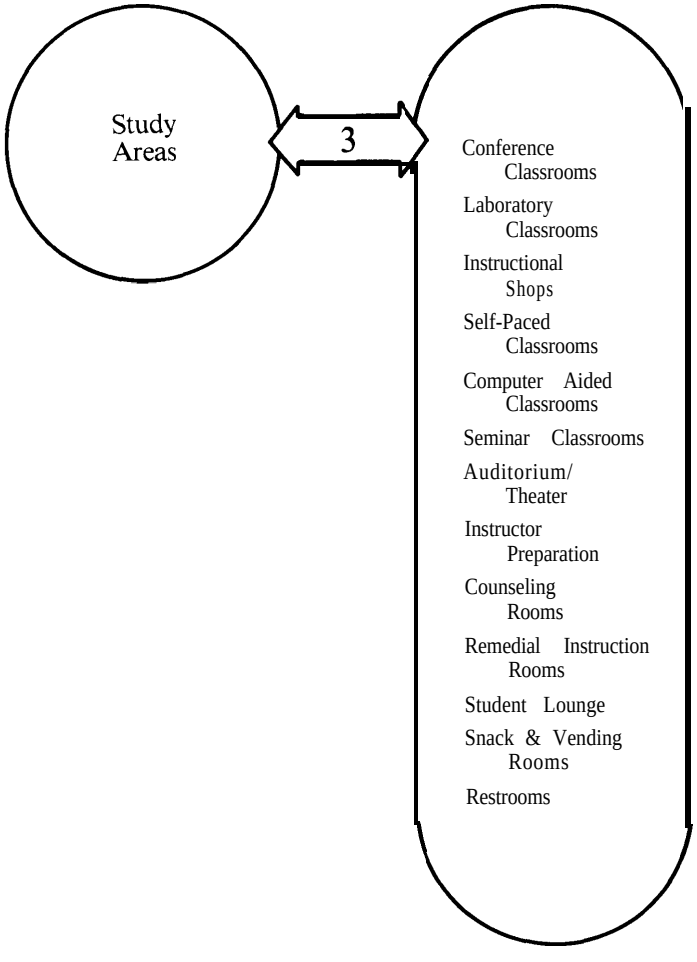


Figure 4-54
Spaces Near Study Areas.

E. Access/Circulation.
See Figure 4-54.

F. Furniture.
Each space should be analyzed to see if special types of furniture are needed. Carrels are needed for viewing self-paced lessons and should be used when students must be free from visual distractions. Carrels, tables, and chairs are needed when students must do written work.

G. Interior Design.

(1) For recommendations, see Figure 4-55. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

H. Criteria.
Table 4-13 lists outline criteria for designing study areas.

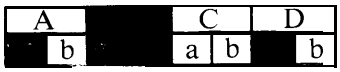
4-15 Projection Rooms.

A. Use/Activities.
This space is used to operate rear-screen projection equipment and to store projection materials. Rear-screen projection rooms which extend into a corner of a classroom can be operated from the instructor's area. Mirrors are used to project the image on a screen, or projectors can be placed in a separate room located behind the screen. Larger projection rooms may have areas for preparing visual programs and/or maintaining equipment.

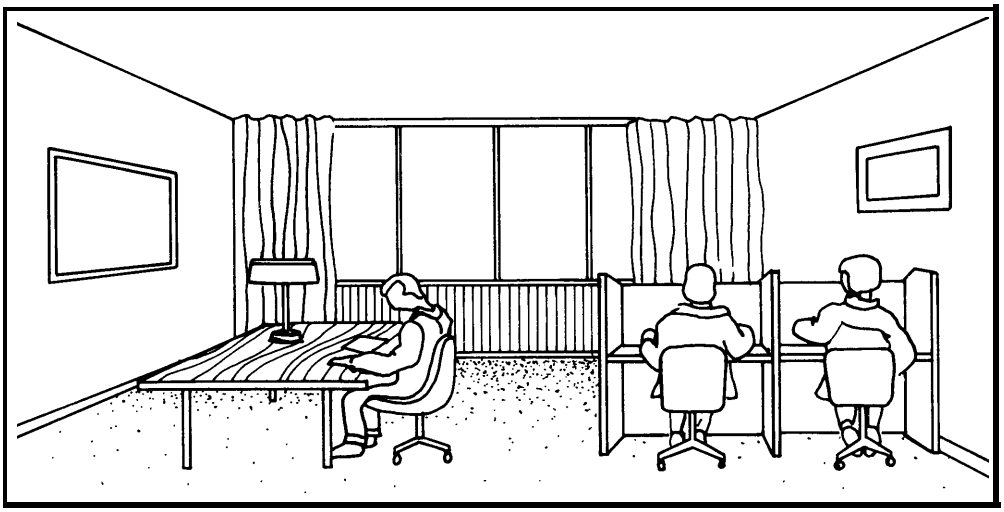
B. Occupants.
Large projection rooms (or projection rooms supporting more than one instructional space) that have a rear-projection screen require space for a projectionist or technician. Depending on the design, instructors may be able to operate projectors themselves or by remote control.

C. Equipment/Supplies.
Projection rooms typically have a slide or movie projector, some storage shelves (which are out of the image path), amplifiers and controls for audio equipment, and lighting controls.

D. Space Utilization.
A projection room or booth should permit displayed images to be large enough to be seen without distortion. Since a rear-screen projector must be at a



Color Scheme



Interior Design Recommendations

Muted colors help to minimize distractions. There should be a variety of furniture types to allow for different modes of study.

Room Finishes

Item	Recommended Characteristics
Floor	Use recommended carpeting.
Walls	Use flat paint in recommended colors.

Furniture & Accessories

Item	Recommended Characteristics
Tables	Plastic laminate is recommended.
Seating	A mixture of comfortable table seating and lounge chairs is recommended.
Carrels	Plastic laminate is recommended.
Lighting	Lighting should be carefully designed to fully meet the task requirements of this room. A professional should be consulted.
Curtains	Open weave curtains are recommended to limit direct sunlight.

Figure 4-55
Interior Design Recommendations for Study Areas.

Table 4-13 Criteria for Study Areas.

Space Criteria	
Area	90 s.f.
Ceiling Height	10 ft.
Floor Loading	50 psf, 70 psf with partitions (minimum)
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task lighting level	50 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between preparation spaces and corridors	STC 40
Between preparation spaces and classrooms	STC 45
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

distance 1.5 times the screen width, the minimum size for a projector room with an 8-foot-wide screen is about 15 feet deep and 10 feet wide.

E. Access/Circulation.

(1.) Access to Space.
The rear-screen projection room should be easily accessible to the instructor. There should be a 3-foot-wide, solid, opaque door between the projection room and the classroom. It is also advisable to have a door which opens into the projection room from an adjoining hallway.

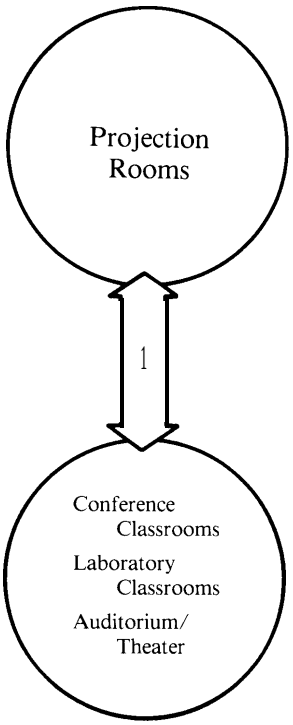


Figure 4-56
Spaces Near Projection Rooms.

(2) Location.
Whenever possible, the rear-screen projection room should serve more than one classroom. (Figure 4-56).

F. Criteria.
Table 4-14 lists outline criteria for designing projection rooms.

4-16 Administrative Offices.

A. Use/Activities.
Service school administrative spaces include the offices of the Commandant, his/her staff, his/her deputies for Combat and Training Development and Training and Education, and the administrative elements of resident instructional departments. (For the specific functions of these organizational elements, see DA PAM 570-558.) Administrative areas typically require private and semi-private offices, clerical spaces, conference rooms, security vaults, and storage areas. These needs may be satisfied by open space planning or conventional office planning.

B. Occupants.
The number of persons an office space may have to accommodate will vary with its function.

C. Equipment/Supplies.
Furniture and equipment needs very widely across organizations. Typical office furniture may meet the needs of many; however, some organizations may need drafting tables, work benches, counters, service windows, or other highly specialized equipment.

D. Space Utilization.

(1) Size.

a. Office space should be based on each occupant's functional needs. Each office space should provide between 80 and 400 square feet per person. Each clerical space should provide between 45 and 90 square feet per person. DG 1110-3-104 provides detailed guidance for planning administrative and office spaces.

Table 4-14 Criteria for Projection Rooms.

Space Criteria	
Area	150 s.f.
Ceiling Height	8 ft.
Floor Loading	50 psf
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Acoustic	
Enclosing sound wall rating: Between projection and class	STC 45
Electrical	
Power	110/120 V

b. Ceiling heights should be appropriate. The ceiling heights for closed offices should be a minimum of 8 feet. Open-plan offices should have ceilings at least 9 feet high.

(2) Open Space Planning.
Offices with much personnel interaction should be organized with a minimum of spatial structuring. (Figure 4-57). Activities such as concept study groups can arrange office furniture and low-height partitions to suit a specific project's organizational requirements; when these projects are done and new requirements arise, the office space can be rearranged. Only a few private offices are provided for personnel whose duties require some isolation from group activities.

(3) Conventional Office Planning.
Offices can also be planned as relatively permanent organizational structures. (Figure 4-58). The floor area, degree of isolation, and location of these offices is based on functional relationships among the occupants. The basic assumption in this type of office planning is that such relationships can be clearly determined and are relatively stable.

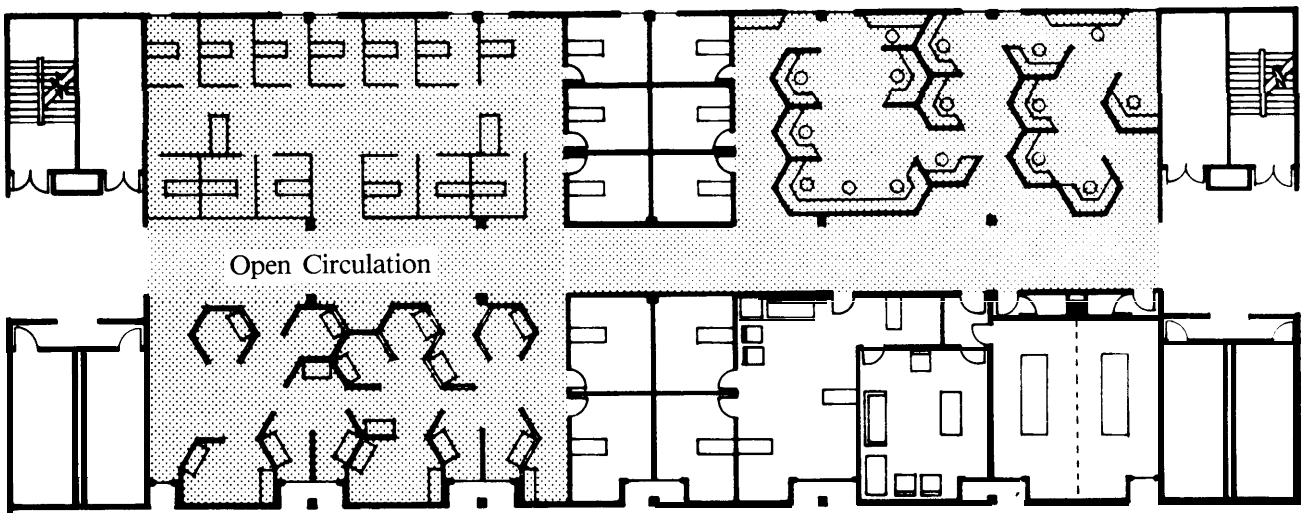


Figure 4-57
Open Office Space Planning.

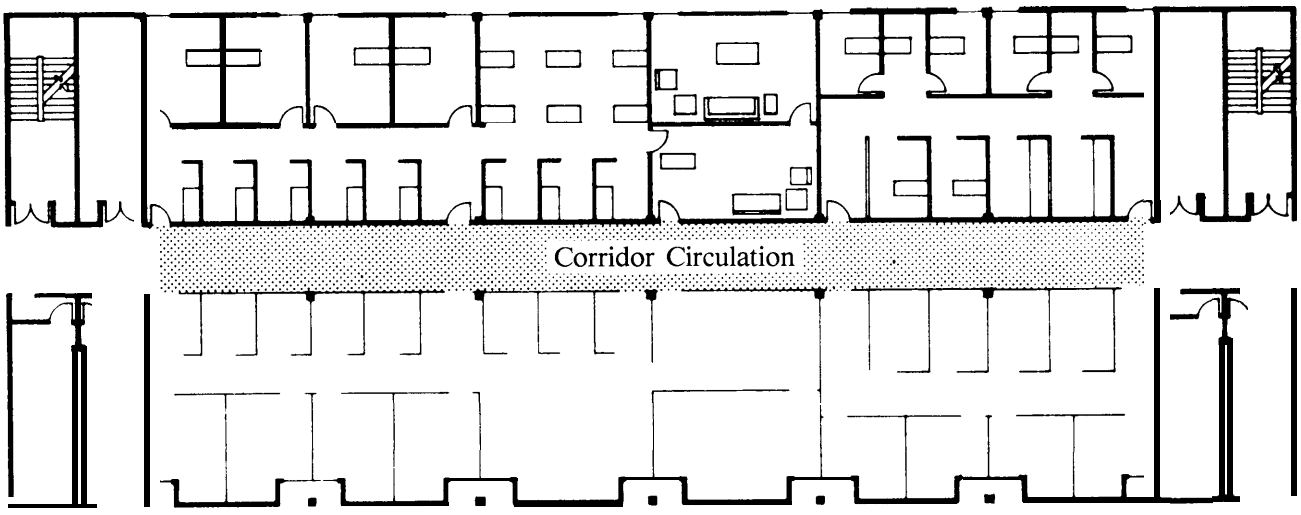


Figure 4-58
Conventional Office Space Planning.

E. Access/Circulation.
See Figure 4-59 and paragraph 5-2 below.

F. Environmental Conditions.
An outside view is essential. Research has shown that most people want an outside view. However, windows should be located to minimize glare and maximize energy conservation. They should provide a northern or southern exposure. With southern exposure, there should be some control of direct sunlight (such as by louvered blinds or curtains).

G. Storage.
Space-saving shelving should be used to conserve floor space. A free-standing shelf unit, if used, should contain three to six shelves before other units are added. Shelving which can be wall-hung, set on desks, or hung on partitions will better use floor space.

H. Interior Design.

(1) For recommendations, see Figure 4-60. For example color schemes called out in the figure, see the Appendix.

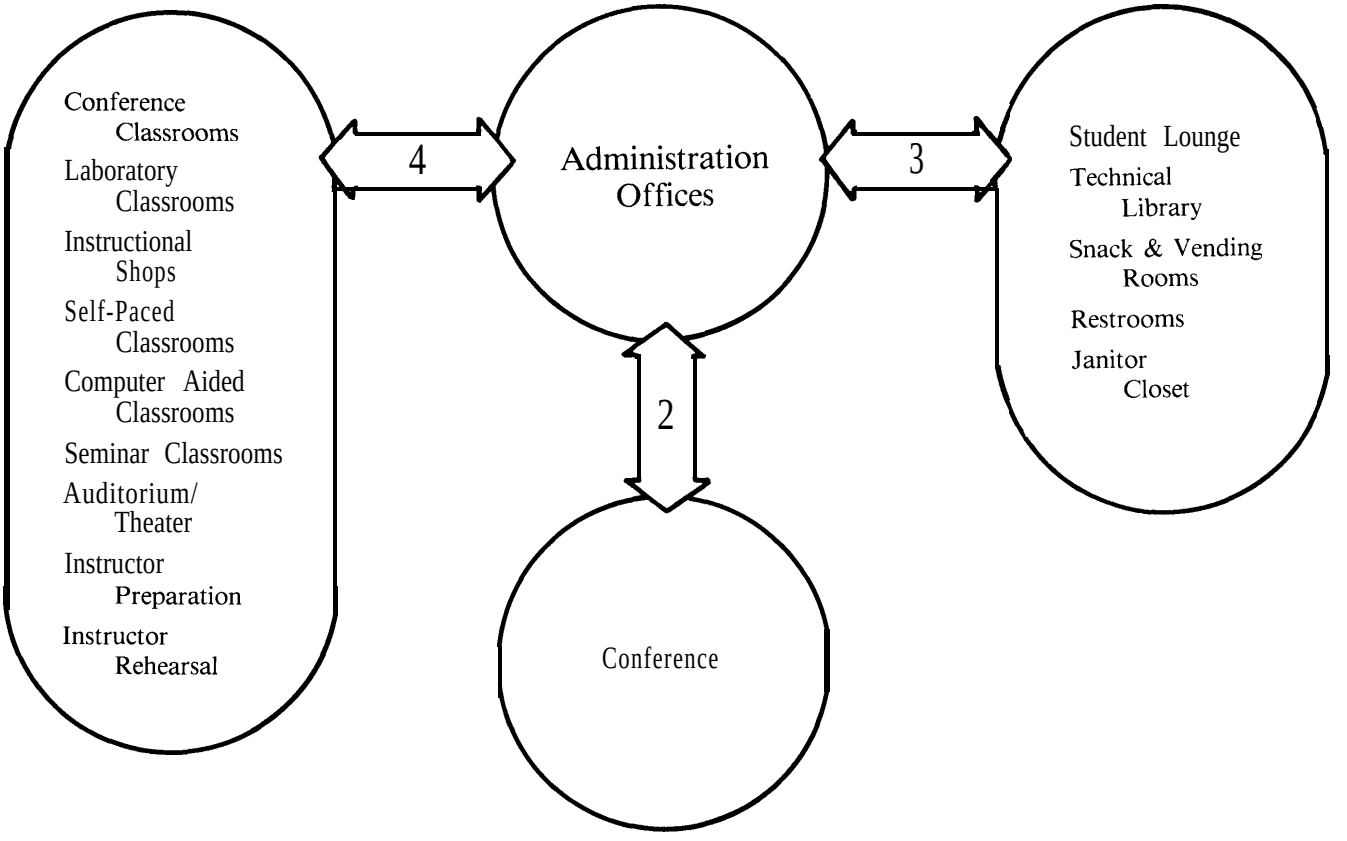
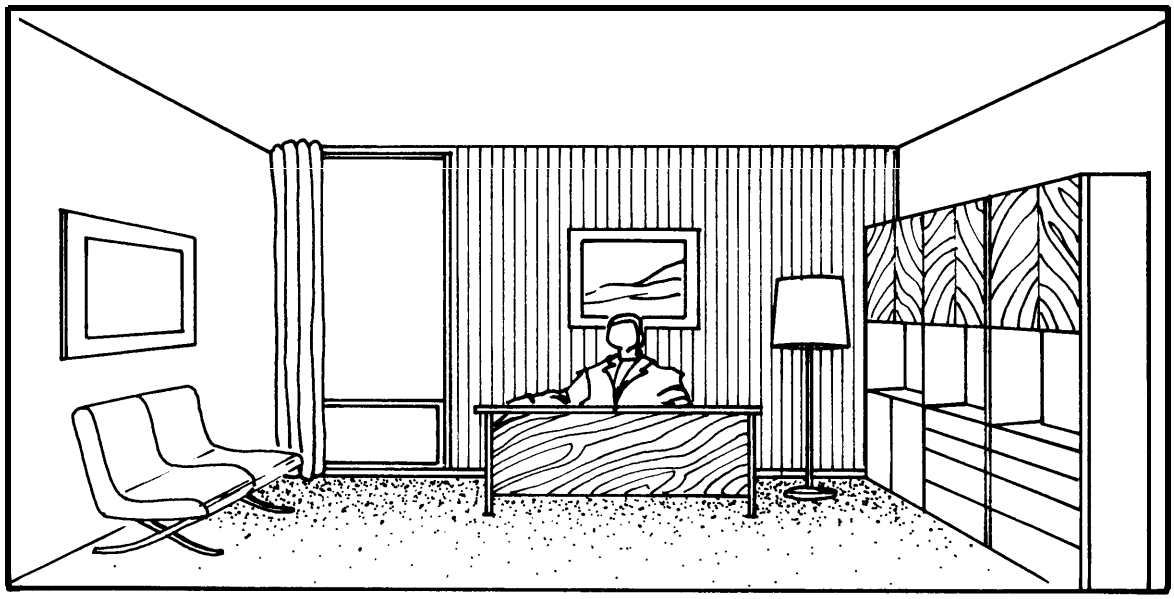


Figure 4-59
Spaces Near Administrative Offices.

	B		C		D
	a	b	a		b

Color Scheme



Interior Design Recommendations

Muted colors help to minimize distractions. There should be a variety of furniture types to allow different modes of study.

Room Finishes

Item	Recommended Characteristics
Floor	Use recommended carpeting.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Comfortable swivel chairs with casters are recommended.
Curtains	Open weave curtains are recommended to limit direct sunlight.

Figure 4-60
Interior Design Recommendations for Administrative Offices.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.
Table 4-15 lists outline criteria for designing administrative offices.

Table 4-15 Criteria for Administrative Offices.

Space Criteria	
Areas	Reference: TM 5-800-1, Administrative Facilities
Offices	80-400 s.f ./person
Clerical Space	45-90 s.f ./person
Floor Loading	Reference: TM 5-800-1, Structural Design
Ceiling Heights	
Enclosed offices	8 ft. minimum
Open plan offices and clerical spaces	9 ft. minimum
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	STC 40
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-17 Administrative Conference Rooms.

A. Use/Activities.
This space is used for meetings, discussions, and presentations. Conference rooms are not used for academic courses. They mainly provide meeting spaces for school organizations which do not involve student instruction.

B. Occupants.
Conference rooms may have to accommodate from six to 25 people at one table. A conference classroom is more appropriate for presentations to larger groups.

C. Equipment/Supplies.
Conference rooms used for meetings and discussions may require one or more tables with chairs. Audio-visual and wall-mounted graphics or chalkboards may also be needed for presentations. A lectern may be desirable.

D. Access/Circulation.
See Figure 4-61.

E. Environmental Conditions.
There should be adequate lighting for each task. The required general lighting level is 50 foot-candles. The A-V lighting level is 30 foot-candles.

F. Interior Design.

(1) For recommendations, see Figure 4-62. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

G. Criteria.
Table 4-16 lists outline criteria for designing administrative conference rooms.

4-18 Student Lounges.

A. Use/Activities.
These spaces are used for visiting, smoking, and relaxing. Some are adjacent or integral to vending machines or short-order snack bars.

B. Occupants.
The number of occupants will vary. Peak occupancy will be between class periods, at lunch time, or during an unscheduled class period.

C. Equipment/Supplies.
Typical lounges have comfortable, informal seating, tables with chairs, and ashtrays.

D. Space Utilization.
Lounges should be large enough to insure comfort and relaxation. There will be 0.1 square foot of lounge space for each square foot of instructional space. Lounge seating will provide 30 square feet per person; lounge standing space will be 6 square feet per person. Ceilings must be at least 9 feet high.

E. Access/Circulation.

(1) Location.
Lounges should be separated from classrooms and laboratories. Student lounges must be located where they do not interfere with teaching. Student lounges should be near latrine and vending areas, but separated from functional areas to allow acoustical isolation. (Figure 4-63 and paragraph 5-2 below).

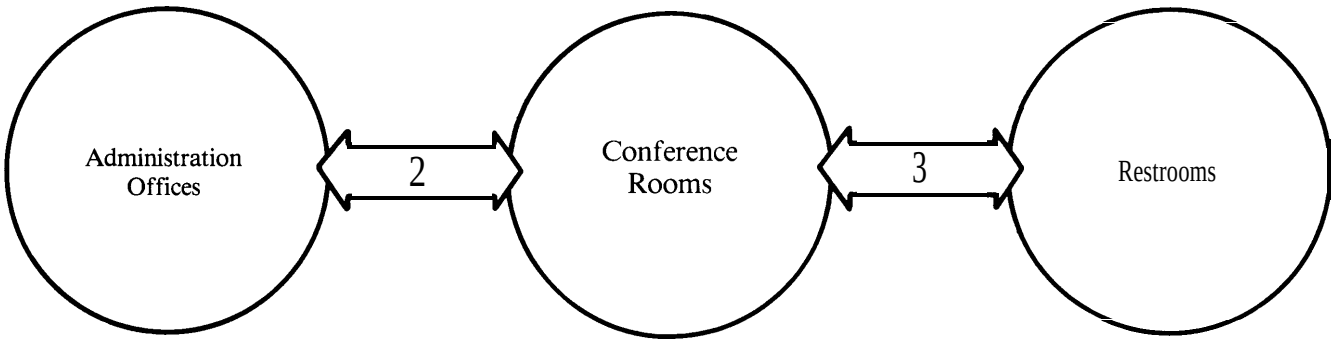
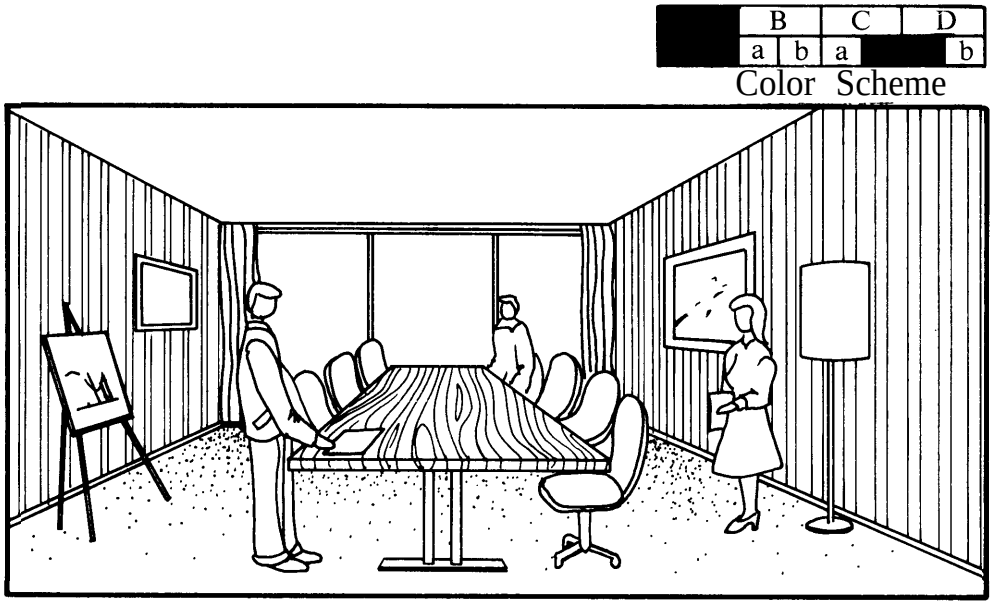


Figure 4-61
Spaces Near Administrative Conference Rooms.



Interior Design Recommendations Design scheme of conference rooms should present a distinguished military appearance.	
Room Finishes	
Item	Recommended Characteristics
Walls	Use flat paint in recommended colors, wallpaper or paneling coordinated with the overall interior design scheme.
Floor	Use recommended carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.
Furniture & Accessories	
Item	Recommended Characteristics
Seating	Comfortable, upholstered chairs on casters should be provided.
Tables	Use laminated plastic or wood veneer.
Curtains	Open weave curtains are recommended to limit direct sunlight. Blackout shades may also be necessary.

Figure 4-62
Interior Design Recommendations for Administrative Conference Rooms.

Table 4-16 Criteria for Administrative Conference Rooms.

Space Criteria	
Area/Person	20 s.f./person
Ceiling Height	10 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Special Characteristics	Student sight lines are critical; depending on the size of audience and nature of the presentation, platforms for instructors and risers for seating may be required.
Seating Spacing	Reference: NFPA-101
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
A-V lighting level	30 fc., reference: paragraph 3-4f
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Reflective
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

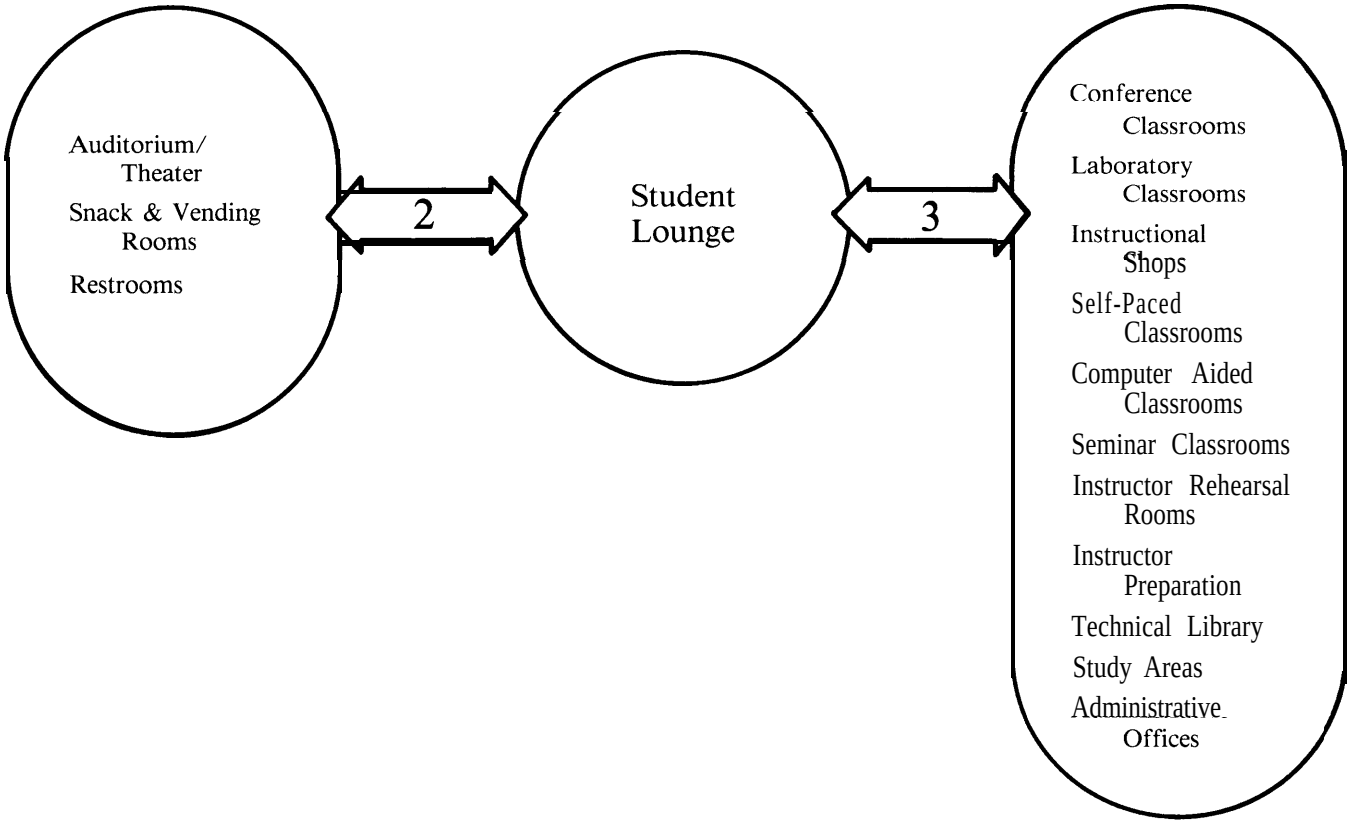


Figure 4-63
Spaces Near Student Lounges.

(2) Vending Areas.
Vending areas should be conveniently located. Each major building should have vending areas. These areas should be easy to service, but placed so as to discourage use by nonschool persons. There should be a vending area in buildings where there is no snack bar or dining facility, or where the nearest exchange facility is 3 to 5 minutes walking distance away.

F. **Environmental Conditions.**

(1) Lighting.
There should be adequate lighting. The general lighting level required is 30 foot-candle (if not otherwise specified).

(2) Thermal.
A mechanical ventilation system should provide adequate air quality. To get rid of smoke, about 30 cubic feet per minute per person of clean air should be provided.

(3) Windows.
Windows help create a relaxed and informal atmosphere by providing daylight and a scenic view. Windows should be provided; a northern or southern exposure is recommended. Direct sunlight from a southern exposure must be controlled by louvered blinds, curtains, etc.

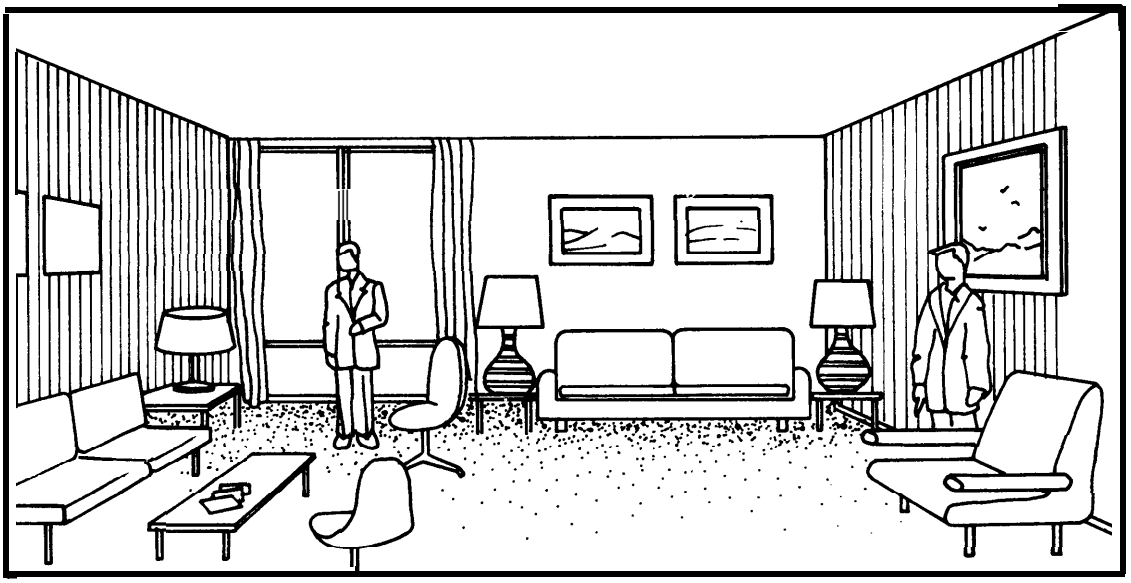
G. Furniture.
Durable tables and chairs should be provided. Furniture should withstand spills of food and drinks, resist cigarette burns, and be easy to wash.

H. Interior Design.

(1) For recommendations, see Figure 4-64. For example color schemes called out in the figure, see the Appendix.

A			C	D
a	b		a b a	

Color Scheme



Interior Design Recommendations
All fabrics, furniture, and finishes should be durable.

Room Finishes	
Item	Recommended Characteristics
Walls	Use flat paint in recommended colors.
Floor	Durable surfaces such as tile are highly recommended.
Trim	Use durable vinyl, hardwood, or metal

Furniture & Accessories	
Item	Recommended Characteristics
Seating	Durable vinyl upholstered sofas and chairs are recommended.
Tables	Laminated plastic tables and end tables are durable and attractive.

Figure 4-64
Interior Design Recommendations for Student Lounges.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.
Table 4-17 lists outline criteria for designing student lounges.

Table 4-17 Criteria for Student Lounges.

Space Criteria	
Area/Person: Seating	30 s.f./person
Standing	6 s.f./person
Ceiling Height	9 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement, air-conditioned	40 cfm (maximum)
Air pressure, mechanical ventilation	100 cfm (maximum)
Air pressure	Negative
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Daylighting	Yes, open view necessary
Acoustic	Location of lounges important to insure no interference with instructional activities
Service Criteria	
Plumbing	Vending machine requirements
Electrical	
Power	110 V

4-19 Snack Bars and Vending Areas.

A. Use/Activities.
These spaces are used to sell food, beverages, candy, and cigarettes to students and school personnel. Vending areas usually have adjacent tables if there is no snack bar or dining facility available. Sometimes vending areas are in student lounges. Snack bars provide full food service if there are no other permanent exchange facilities immediately available, and they include a dining room. The Army and Air Force Exchange System (AAFES) normally operates snack bars and vending areas. Detailed programming and design requirements must be obtained through the local AAFES office. Requests for information and coordination should be directed to HQ AAFES, Dallas, TX 75222.

B. Occupants.
The number of students, school staff, and faculty and food service personnel these spaces must accommodate depends on the size and type of the school's food facility. The AAFES operates vending areas and snack bars. Full dining services may be contracted.

C. Equipment/Supplies.
The AAFES determines the type of food preparation, display, vending, or serving equipment used in these spaces. These areas typically have vending machines, waste containers, condiment displays, microwave ovens, and either standup-type tables or tables with chairs.

D. Space Utilization.
These spaces must be large enough to allow users to buy and eat food comfortably. Snack bars/vending areas will provide 12 square feet per seating space; 20 square feet are provided per vending machine.

E. Access/Circulation.
Snack bars should be centrally located, near vertical circulation routes and toilets and directly accessible to a dock for deliveries and trash removal. Although administratively independent of the school, they should relate visually to other school facilities. A vending area should be located within each major building in a place that will discourage its use by nonschool personnel, but still be easy to service. (Figure 4-65 and paragraph 5-2 below).

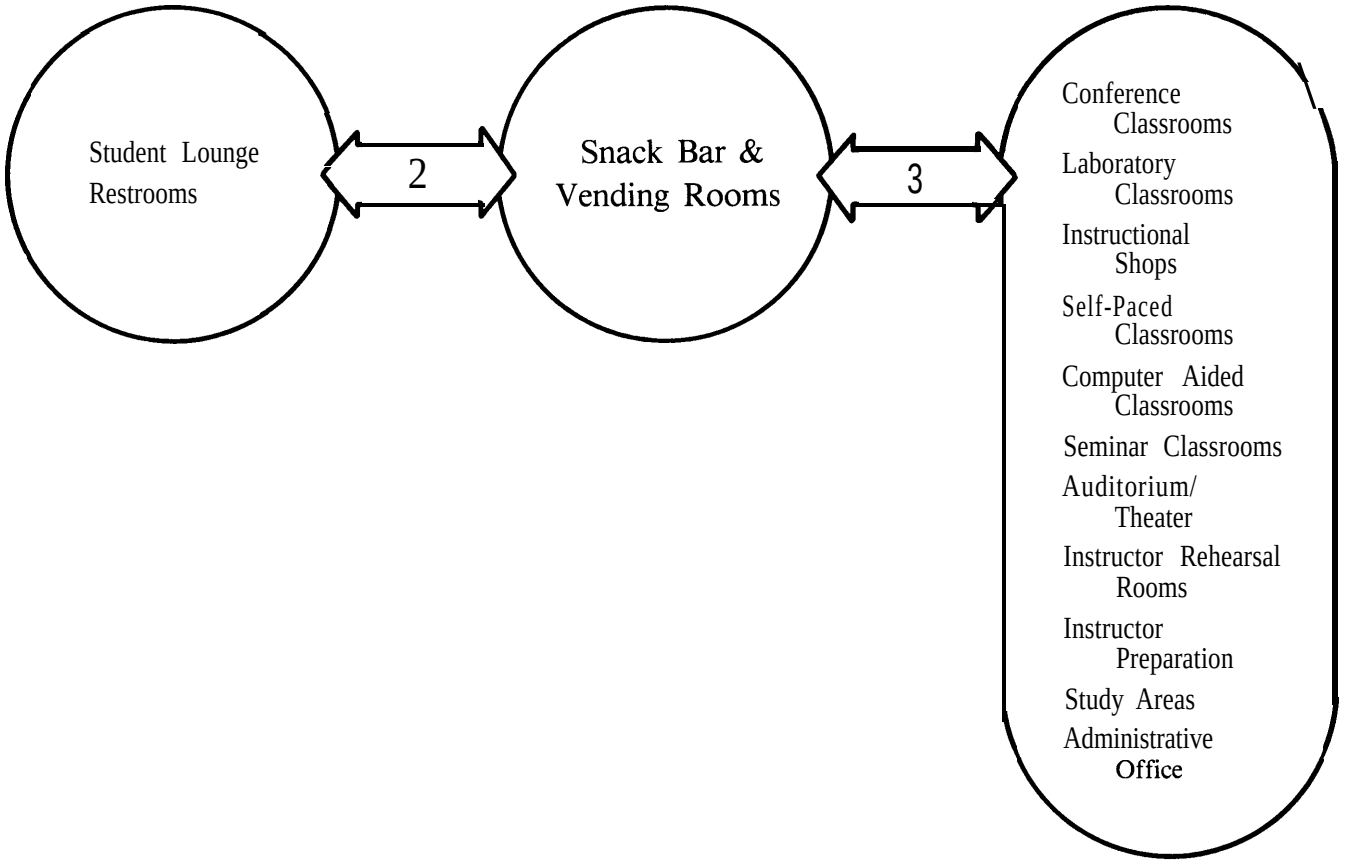


Figure 4-65
Spaces Near Snack Bars and Vending Areas.

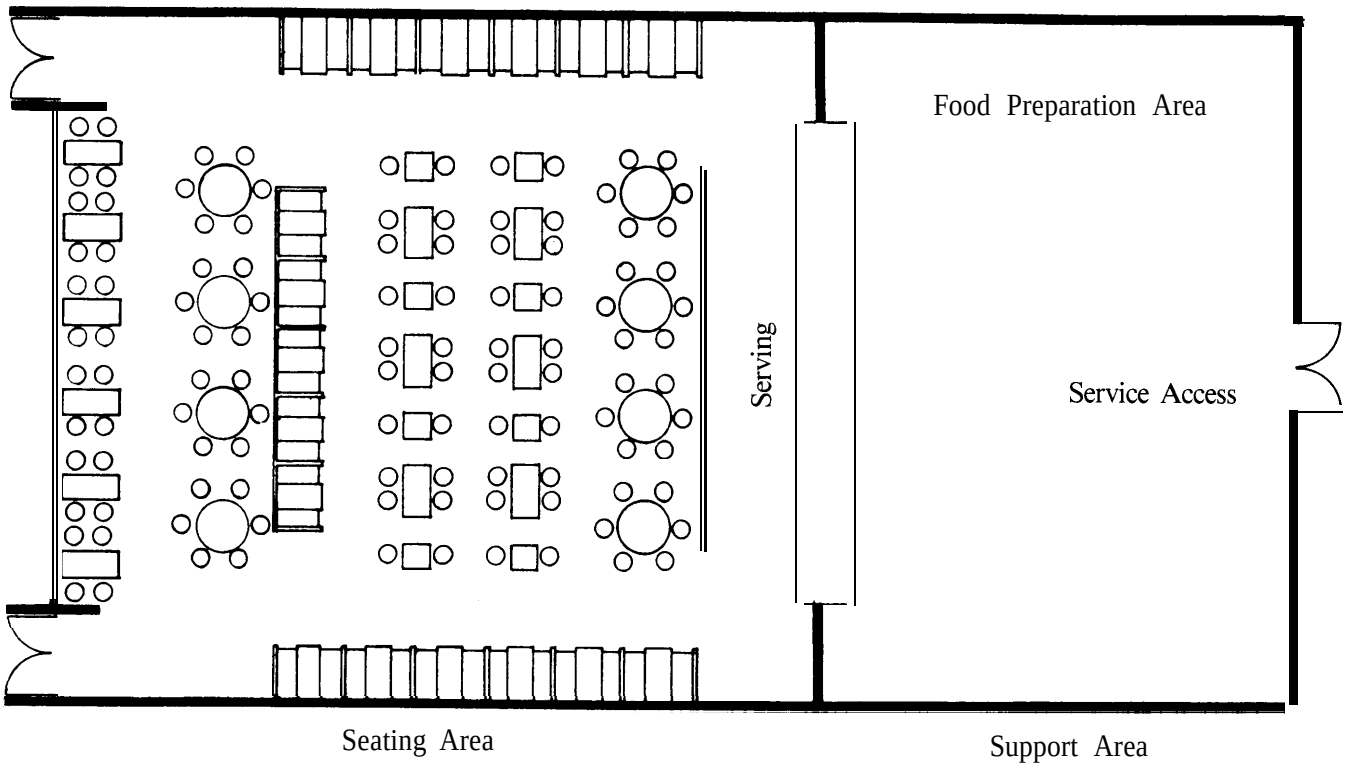
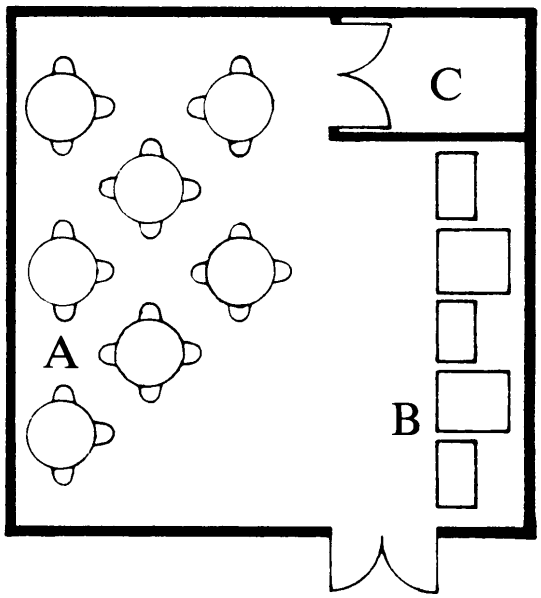


Figure 4-66
Snack Bar Facility.

F. Storage.
The vending area needs nearby storage for stock. The Exchange System sets storage requirements.

G. Environmental Conditions.
Windows should be provided to the full extent allowed by energy conservation regulations.

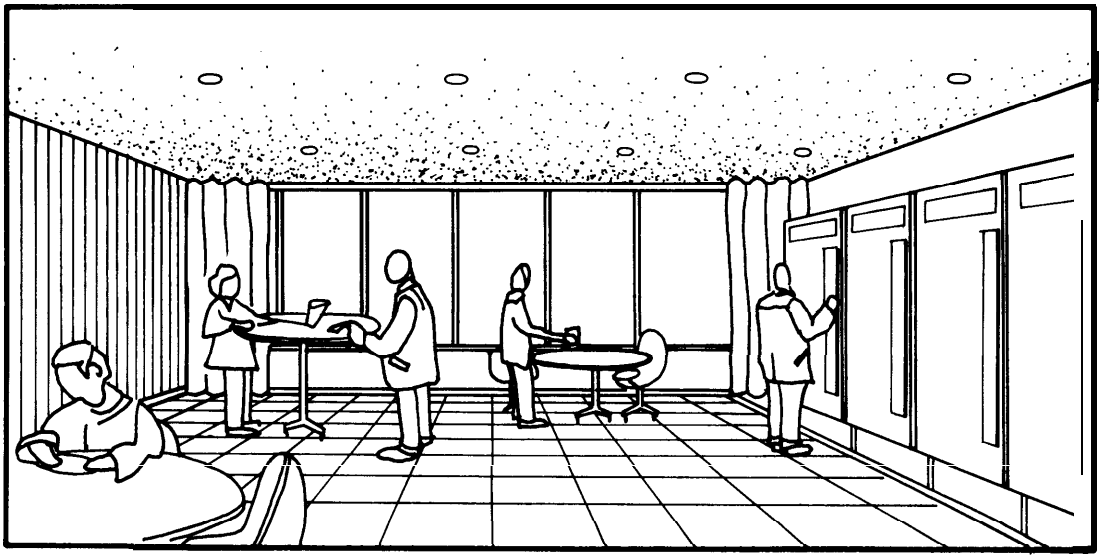


A Seating
B Vending
C Storage

Figure 4-67
Vending Area With Seating.

A		C	D
a b		a b	a

Color Scheme



Interior Design Recommendations
All table surfaces should be laminated plastic. All fabrics, furniture, and finishes should be durable and easy to clean

Room Finishes	
Item	Recommended Characteristics
Walls	Use semi-gloss paint in light shades of recommended colors.
Floor	Durable tile is recommended.
Trim	Use durable vinyl, hardwood, or metal.

Furniture & Accessories	
Item	Recommended Characteristics
Seating	Durable vinyl upholstered or molded plastic chairs are recommended.
Tables	Use laminated plastic for table top surfaces.

Figure 4-68
Interior Design Recommendations for Snack Bars and Vending Areas.

H. Furniture.
Durable tables and chairs must be provided. Furniture should withstand food and drink spills, be easy to wash, and resist cigarette burns. A mixed seating arrangement consisting of two- and four-place rectangular tables, four-place booths, and six-place round tables should be provided to accommodate various sizes of customer groups. (Figures 4-66 and 4-67).

I. Interior Design.

(1) For recommendations, see Figure 4-68. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

J. Criteria.
Table 4-18 lists outline criteria for designing snack bars and vending areas.

Table 4-18 Criteria for Snack Bars and Vending Areas.

Space Criteria	
Area	12 s.f. per seat; 20 s.f. per vending machine
Ceiling Height	9 ft. minimum
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	15 per hour (dining); 25 per hour (kitchen)
Air movement	40 cfm (maximum) dining
Air pressure	Positive (dining); Negative (kitchen)
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Serving lighting level	50 fc. (maintained)
Daylighting	Required
Acoustic	
Enclosing sound wall rating:	STC 45
Sound reflectance: Ceiling	Absorptive
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Clock control as programmed

4-20 Bookstore.

A. Use/Activities.
The service school bookstore sells supplemental training documents, stationery supplies, technical books, and related materials. The AAFES normally operates bookstores. Detailed requirements for programming and design must be obtained through the local AAFES office. Requests for information and coordination should be directed to HQ AFFES, Dallas, TX 75222.

B. Access/Circulation.
The store should be centrally located, near the main entrance, and accessible to a loading dock for deliveries (paragraph 5-2 below).

C. Criteria.
Table 4-19 lists outline criteria for designing bookstores.

Table 4-19 Criteria for Bookstores.

Space Criteria	
Area	Reference: paragraph 4-12
Ceiling Height	9 ft. min.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour
Air movement	40 cfm
Air pressure	Negative
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Daylighting	Yes
Acoustic	
Enclosing sound wall rating:	STC 45
Sound reflectance: Ceiling	Absorptive
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Clock control as programmed

4-21 Restrooms

A. Use/Activities.
In some cases, restroom areas will also have shower and locker rooms.

B. Occupants.
The population served by a restroom will vary by school and by building layout.

C. Equipment/Supplies.
The type and number of restroom fixtures will vary with the population and area served. When restrooms are renovated, provisions for the physically handicapped must be included.

D. Space Utilization.
AEI - Design Criteria, Chapter 15, for guidance on size.

E. Access/Circulation.

(1) Location.
Washrooms should be convenient to users. Both men's and women's restrooms should be near the administrative area. There should be one restroom (both men's and women's) on each floor of the classroom area. Groups of restrooms should be spaced at intervals not to exceed 500 feet. (Figure 4-69).

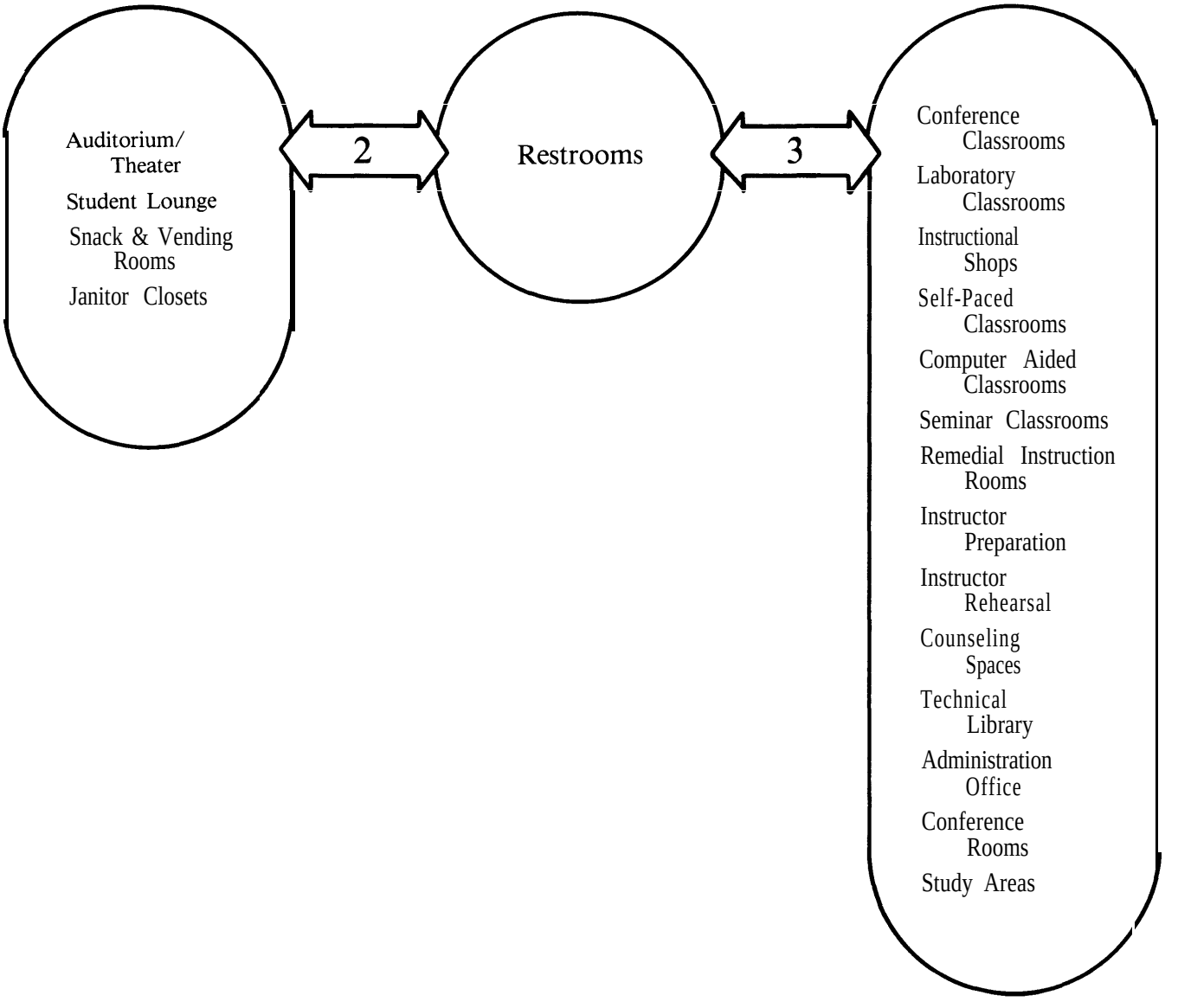


Figure 4-69
Spaces Near Restrooms.

(2) Fixture Arrangement.
Fixtures' arrangement should minimize traffic congestion. The usual arrangement of restroom fixtures is lavatories nearest the door, followed by urinals, water closets, and dressing rooms. Where space is lacking, these fixtures are typically placed along a narrow corridor; urinals are nearest the door to allow a wider aisle.

(3) Fixture Layout.
Fixture layout should be accessible to the handicapped. Refer to AEI - Design Criteria, Chapter 7.

F. Utilities and Wastes.
Restrooms must have enough sewer capacity to support increased use during hourly breaks. Careful consideration should be given to restroom fixture arrangement and its effect on the plumbing and pipe runs. Fixtures should be arranged in batteries. Stall urinals need a trap beneath the floor level. If the floor-slab thickness will not accommodate the trap's indicated average dimension, urinals may be placed on a platform 4 inches high by about 2 feet wide and their surface pitched to the fixtures.

G. Environmental Conditions.

(1) Lighting.
Lighting should be appropriate for washrooms. In general, 20 to 30 foot-candles will adequately light a restroom. Lights should directly illuminate lockers, lavatories, and showers.

(2) Ventilation.
Restrooms must be well ventilated to control odor; 2.0 to 2.5 cubic feet per minute of exhaust ventilation without recirculation is recommended per square foot of floor area. A minimum of 1.5 cubic feet per minute per square foot should be provided.

H. Furniture.

(1) Fixtures.

a. Lavatory fixtures should be chosen for appearance, durability, and ease of cleaning. Lavatories may be leg, counterset, or wall-hung. Wall-hung types are easiest to clean; however, they must be supported on suitable chair carriers to avoid unsightly cracks between wall and fixtures. Lavatories should be white or a light color.

b. Water closets should be selected for appearance, durability, and ease of cleaning. Water closets are either wall-hung or floor (pedestal) types. Floor-type water closets are hard to clean and are recommended only for restrooms whose use will be restricted. Wall-hung water closets are generally recommended for normal-use restrooms. Water closet seats should be unbreakable and have open fronts and an impervious surface. Color recommendations are the same as for lavatories. Self-metering flush valves are recommended for all types.

c. Urinals should be chosen for appearance, durability, and ease of cleaning. Three kinds of urinals can be used: stall, wall-hung, or pedestal types. The wall-hung type is recommended. Partitions or fins are usually placed between pedestal or wall-hung urinals, but rarely between stall urinals. Many wall-hung urinals have integral shields which serve as partitions. If the space between stall urinals is too small for easy cleaning, pockets should be filled flush with impervious surface materials. Urinals are usually white or light-colored.

(2) Partitions.

a. Partition systems should be chosen for appearance, durability, and ease of cleaning. Partitions should stop about 1 foot above the floor for air circulation. Various kinds of metal partitions are available; these include post-and-panel assemblies (with or without overhead bracing) and flush panels with integral posts (floor-supported or ceiling-hung). (Figure 4-70). Floor-mounted partition systems are usually more durable than other types; ceiling-hung types make floor cleaning easy. Partition colors should fit with overall room decor. Subdued and neutral colors are recommended. Partitions should resist corrosion. Compartment dimensions depend on whether doors swing inward or outward.

b. Accessories for restrooms should be easy to use, durable, attractive, and easy to clean and service. Finishes on accessories should be noncorrosive. Double-roll, 15,000-sheet toilet tissue dispensers are recommended. One towel dispenser should serve no more than three lavatories. Automatic hand driers should serve no more than two lavatories. One soap dispenser should be provided for every two lavatories. Dispensers for waterless or other special hand cleaners should be provided in restrooms near laboratories and shops. Each lavatory should have a shelf. Waste containers for paper towels should have an 8- to 10-gallon capacity per towel dispenser. Waste containers should meet Occupational Safety and Health Administration (OSHA) regulations and be easy to remove and empty. Each women's water closet should have a feminine napkin dispenser; these dispensers should include disposal bags. When a women's restroom includes a lounge, there should be an ashtray with each couch.

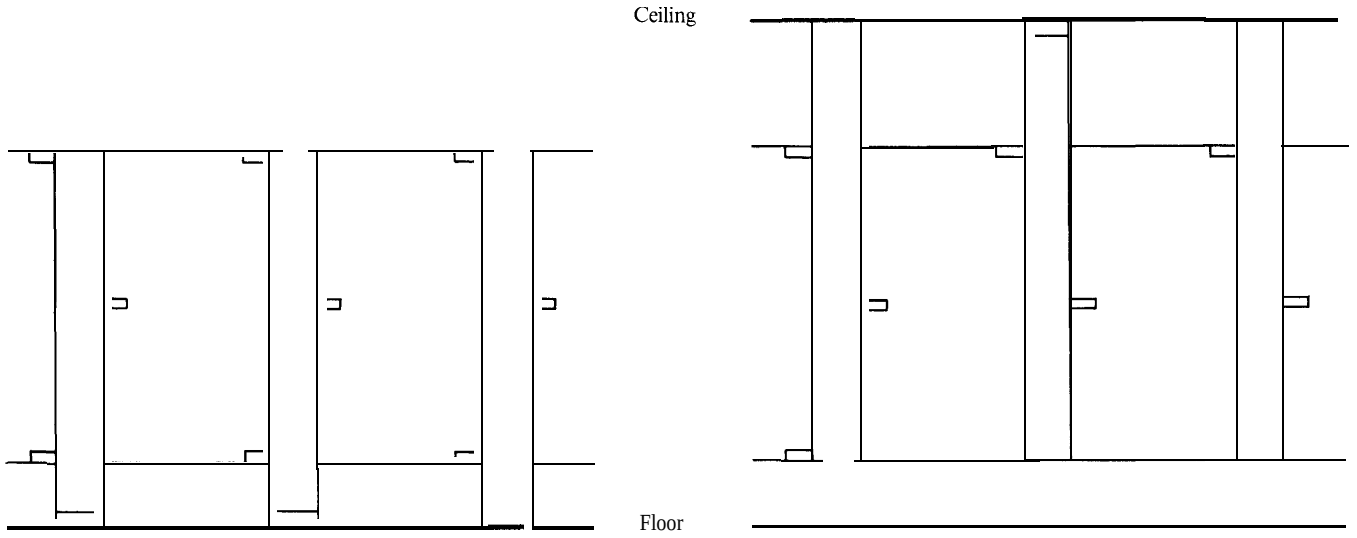


Figure 4-70
Toilet Partition Types.

I. Interior Design.

(1) Maintenance.
All surfaces should be durable. Restroom walls, floors, and ceilings must resist water and water-borne dirt penetration. Floors should be strong enough to support heavy traffic, and soap, water, acid, and alkali contamination. Fixtures should be durable enough to withstand heavy use and cleaning. Restrooms ceilings can be acoustically treated. Items that should be included or considered for restroom use are suitable floor drains in toilet and locker rooms, and hose bibs in toilet and locker rooms.

(2) Recommendations.

a. For recommendations, see Figure 4-71. For example color schemes called out in the figure, see the Appendix.

b. For general guidance on interior design, see DG 1110-3-122.

J. Criteria.
Table 4-20 lists outline criteria for designing restrooms.

4-22 Janitor Rooms.

A. Use/Activities.
These spaces are used to store janitorial supplies and equipment, to obtain water (for mopping), and to dump wastewater. They may also be holding areas for solid waste. In office areas, janitor closets are often used to fill coffee urns or to dump coffee grounds. Management of janitorial services will vary locally; in some cases, such services will be contracted. School personnel will also use these areas for routine or emergency cleanup activities.

B. Occupants.
The number of janitorial and/or school personnel that will use the janitor closets depends on the size of the school and how janitorial services are managed.

C. Equipment/Supplies.
The amount and type of equipment and supplies to be stored in janitor closets will vary. Sometimes, buffers and floor-cleaning machines, as well as mops and brooms, must be stored. Security for expensive equipment or for contractor-furnished equipment may be needed. Furniture for a supervisor work station (desk and file) may be needed.

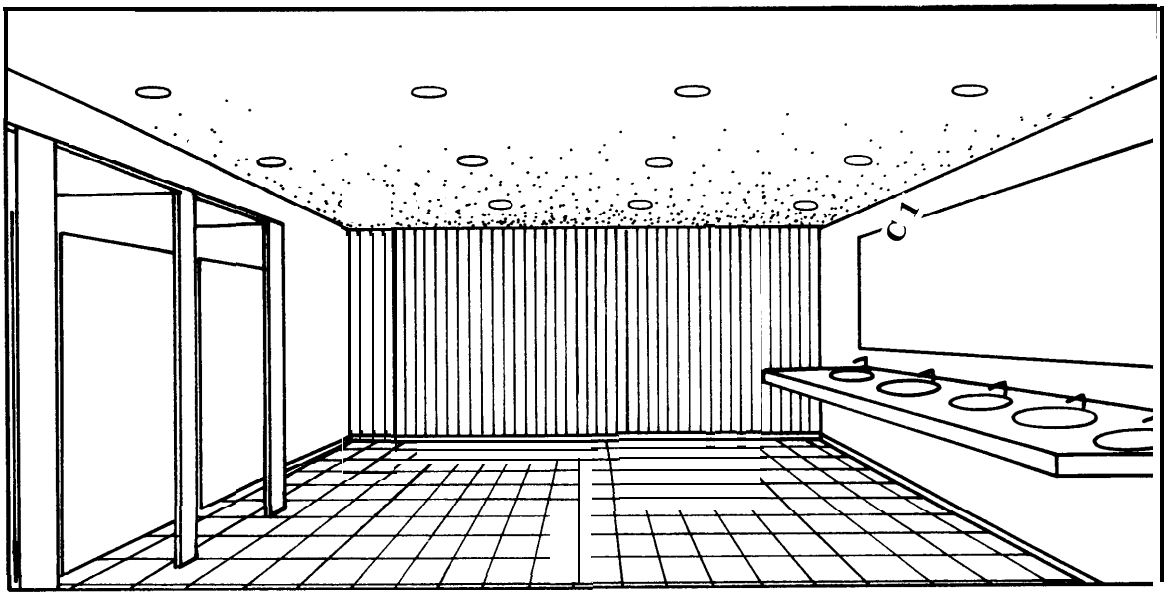
D. Space Utilization.

(1) Size.
Each janitor closet should be 48 square feet.

(2) Shape.
The ceiling should be at least 8 feet high, and the room dimensions should be at least 6 by 8 feet.

A		C	D
a	b	b	a

Color Scheme



Interior Design Recommendations

The primary decor concern in restrooms is surface cleanability, durability, and imperviousness to water.

Room Finishes

Item	Recommended Characteristics
Walls	Ceramic tile in recommended colors must be applied to at least the lower five feet of all restroom walls. Gloss paint in recommended colors may be used from the top of the tile to the ceiling.
Floor	Use ceramic tile in recommended colors.

Furniture & Accessories

Item	Recommended Characteristics
Walls	Partition walls should be of a non-rust metal.

Figure 4-71
Interior Design Recommendations for Restrooms.

Table 4-20 Criteria for Restrooms.

Space Criteria	
Area	Reference: Space Use
Ceiling Height	9 ft. minimum
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	2.5 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Negative
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Acoustic	
Enclosing sound wall rating:	STC 45
Sound reflectance: Ceiling	Absorptive
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Clock control as programmed

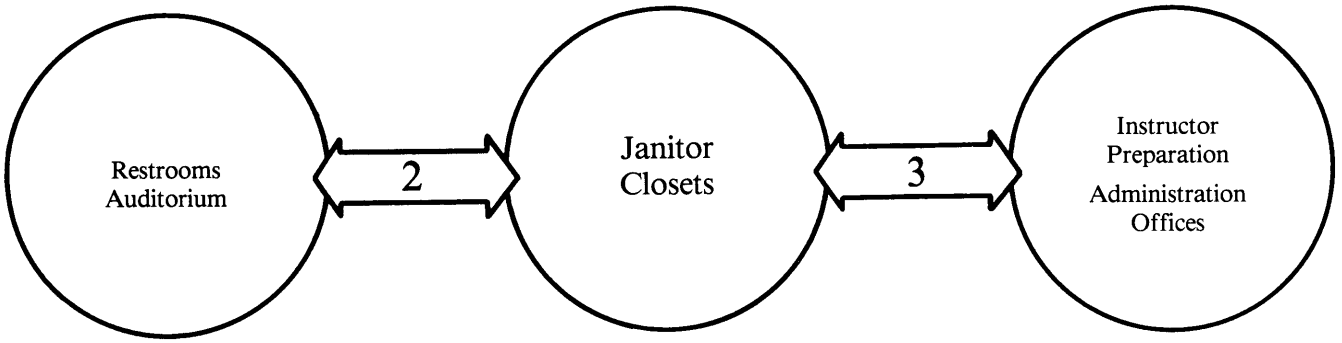


Figure 4-72
Spaces Near Janitor Rooms.

E. Access/Circulation.

(1) Location.
There must be a closet on every floor. One closet is enough for a floor between 9000 and 15,000 square feet. In larger buildings, two closets per floor may be needed. Each janitor closet should be centrally located within the area it serves. (Figure 4-72).

(2) Access.
Janitor closets should be easy to enter but screened from general view. The door to the janitor closet should be self-closing and have a foot-operated doorstop. The door should not have a window and should be labeled "JANITOR" on the outside.

F. Utilities and Waste.
Each janitor closet should have a floor drain.

G. Environmental Conditions.

(1) Lighting.
Each janitor closet should have at least a 30-foot-candle lighting level.

(2) Thermal.
Ventilation should be provided to prevent mildew and odors. There must be at least 0.15 cubic foot per minute of ventilation air per square foot of floor area.

H. Furniture.

(1) The janitor closet should have a cork bulletin board for user or employee notices. Corkboards should be 18 by 24 inches, hung at a convenient height, and on a wall that is away from stacked equipment or boxes.

(2) There should be enough storage for cleaning chemicals and equipment.

(3) Each janitor closet should have a floor service sink with hot and cold water and a 53-foot length of hose.

I. Interior Design.
Floors and walls should have an unmarrable finish. Floors and walls should be salt-glazed brick, ceramic tile, or similar, easily cleaned materials.

J. Criteria.
Table 4-21 lists outline criteria for designing janitor rooms.

4-23 Storage.

A. Use/Activities.
This type of space is used exclusively for storage.

B. Occupants.
Storerooms typically do not have occupants. In a few cases, large storerooms may have someone located near the entrance to control and distribute contents. Storerooms may belong to one organization or may be shared by several.

C. Equipment/Supplies.
The contents of storerooms may include office and general supplies, A-V equipment, mockups, or other training aids. Storerooms may be partitioned for use by several organizations.

D. Space Utilization.
Actual storeroom area will vary with the school's various needs and uses.

E. Access/Circulation.

(1) Location.
Storerooms which house large equipment should be located on an outside wall of the building so they can be accessed from the outside. Infrequently used storerooms should be located in an out-of-the-way area. (Figure 5-2).

(2) Openings and Access.
Materials and equipment should be easy to move. Storerooms should have an overhead (garage-type) door if movement of large equipment and materials is likely. Double doors (i.e., two 3-foot doors) should be provided to allow access from a corridor.

F. Furniture.
Storage rooms should be planned and equipped to keep contents orderly. Enough shelving, cabinets, and racks should be provided and sized to accommodate the items to be stored.

Table 4-21 Criteria for Janitor Rooms.

Space Criteria	
Area	Reference: Space Use
Ceiling Height	9 ft. minimum
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour
Air movement	40 cfm (maximum)
Air pressure	Negative
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Acoustic	
Enclosing sound wall rating:	STC 45
Sound reflectance: Ceiling	Absorptive
Walls: Front	Reflective
Side	Reflective
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Clock control as programmed

G. Special Features.
Internal secure areas should have adequate storage space. A guard and/or an alarm system can be used to provide storeroom security. Keyed locks must be installed.

H. Interior Design.
Surfaces should be durable and easy to maintain. Concrete block walls and concrete floors should be used.

I. Criteria.
Table 4-22 lists criteria for designing storage rooms.

Table 4-22 Criteria for Storage Rooms.

Space Criteria	
Area	Reference: Space Use
Ceiling Height	9 ft. minimum
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour
Air movement	40 cfm (maximum)
Air pressure	Negative
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Acoustic	
Enclosing sound wall rating:	STC 45
Sound reflectance: Ceiling	Absorptive
Walls: Front	Reflective
Side	Reflective
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Clock control as programmed